

DP-4900/DP-6900/SK-40

Digital Ultrasonic Diagnostic Imaging System

Service Manual

Revision 6.0

Version information

Ver.	System Date	Revision description
1.0	2007.9	Initial version
2.0	2009.5	Modify Keyboard PCBA theory
3.0	2009.10	Increase new electric safety test
4.0	2010.7	Use new LOGO
5.0	2011.7	Add new model type
6.0	2012.9	Update the test items, test methods and limits of electrical safety inspection.

Affected page list

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A-8,A-11,A-14,A-16	The limits of test items	6.0
A-1-1	Electrical Safety Inspection Form.	6.0

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For this Service Manual, the issued Date is 2012-09.

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2. Freight policy: The customer is responsible for freight charges when this product is shipped to Mindray for service (this includes customs charges).
3. Return address: Please send the part(s) or equipment to the address offered by Customer Service department




Company Contact

Manufacturer:	Shenzhen Mindray Bio-medical Electronics Co., Ltd.
Address:	Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen 518057, P. R. China
Phone:	+86 755 26582479 26582888
Fax:	+86 755 26582934 26582500



Safety Precautions

1. Meaning of Signal Words

In this operator's manual, the signal words  **DANGER**,  **WARNING** and **NOTE** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meaning before reading this manual.

Signal word	Meaning
 DANGER	Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
 WARNING	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

2. Meaning of Safety Symbols

Symbols	Description
	Type-BF applied part The ultrasound transducers connected to this system are Type-BF applied parts.
	"Attention" indicates the points that you should pay attention to. Be sure to read the operator's manual concerning these points before using the system.

3. Safety Precautions


Please observe the following precautions to ensure patient's and operator's safety when using this power.

⚠DANGER: Do not use flammable gasses, such as anesthetic gas, oxygen or hydrogen, or flammable liquids such as ethanol, near this power, because there is danger of explosion.

⚠WARNING:


1. Do not charge the device within PATIENT ENVIRONMENT.
 2. When the DC input cable is connected to the DC output (cigar lighter of a vehicle) or the mobile power, do not touch the patient and the metal part of the DC input cable simultaneously.
 3. After charging through the cigar lighter of a vehicle, the connector of the DC input cable may get hot. Do not touch the metal part of the connector to avoid scald.
 4. ⚡ Electric shock hazard! Refer all servicing to qualified service personnel only.
 5. Do not place the device in locations near fire, high temperature, inflammable and explosive material and locations exposed to direct sunlight.
 6. The mobile power is an internally powered device, which
 - 1) will warn when battery low (L2 yellow, dual buzzes every 30 seconds) and stop AC output automatically when battery exhausted; and
 - 2) may activate self-protection and stop AC output when environment temperature is high, which will shorten the service time;so be careful when using the device as a power supply.
 7. Do not immerse the device into water. Do not try to put out a fire with water. Do not block the ventilation slots.
-
-

NOTE:

1. After using the device or when the device stops AC output automatically due to exhausted battery, please switch off the AC OUT to avoid over discharging. Charge the device immediately if possible to avoid performance degrading or even permanently damage.
 2. If the device is not used for a long time, put the device in locations shady and cool with the battery full of power and the switch of AC output off. Maintain the device by charging periodically (about every 3 months).
 3. Do not connect the device to AC/DC input when using the mobile power as a power supply, or the device will stop the AC output which may cause data lost.
 4. Do not plug in AC INPUT and DC INPUT cables simultaneously.
 5. This device is for Mindray portable black-and-white ultrasonic system only. Do not connect devices other than those specified.
 6. Keep the device horizontal to avoid falling.
 7.  Do not remove protective covers. No user serviceable parts are inside.
 8. Electrical and mechanical performance may be degraded due to long usage (such as current leakage or distortion and abrasion). To ensure the performances of this device, please perform periodical checks for the device.
 9. To dispose of the system or any part, contact Mindray Customer Service Department or sales representative. Mindray is not responsible for any system content or accessories that have been discarded improperly.
-










4. Warning Labels

The warning labels are attached to this system in order to call your attention to potential hazards.

The symbol  on the warning labels indicates safety precautions. The warning labels use the same signal words as those used in the service manual.

Refer to the service manual for detailed information about the warning labels. Read operator's manual carefully before using the system.

5. Symbol Explanation

Symbol	Meaning	Position
	Main unit power is off	Power switch
	Main unit power is on	
	Video print control interface	On the input /output panel
	Video output	
	VGA output	
	Interface of footswitch	
	USB interface	
	Network interface	
	Probe socket A	Probe socket
	Probe socket B	

1 System Introduction

1.1 Intended Use

The DP-6900 is universal B-mode digital diagnostic ultrasound system intended for use in ultrasound exams for human.

The DP-4900/SK-40 is arised from DP-6900 by simplifying some functions and reducing some performances, which is also intended for use in ultrasound exams for human.

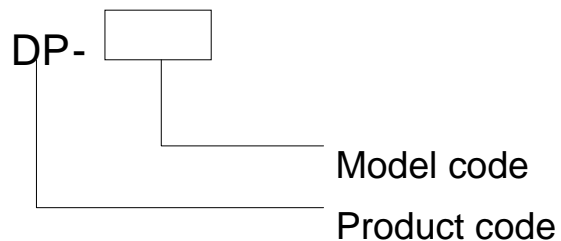
The DP-6900Vet modified from DP-6900 is B-mode digital diagnostic ultrasound system, which is intended for use in ultrasound exams for animals.

The DP-4900Vet modified from DP-4900 is digital diagnostic ultrasound system, which is intended for use in ultrasound exams for animals.

1.2 Contraindication

None.

1.3 Product and Model Code



2

System Structure

2.1 Introduction of Each Unit

2.1.1 Appearance of the System

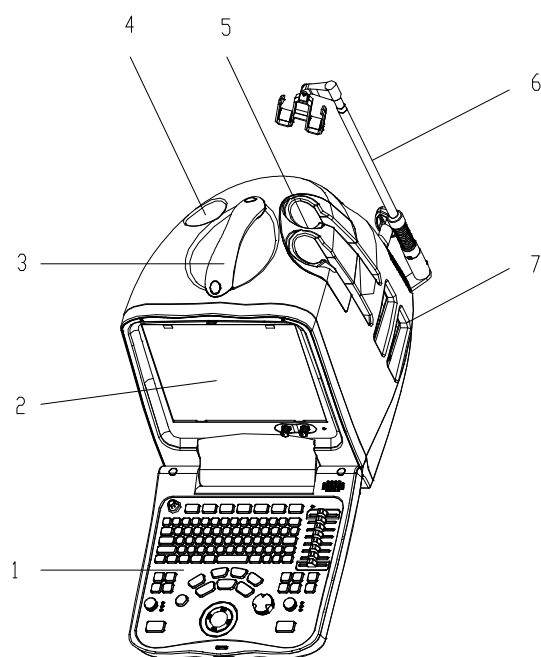


Figure 2-1 Appearance (1)

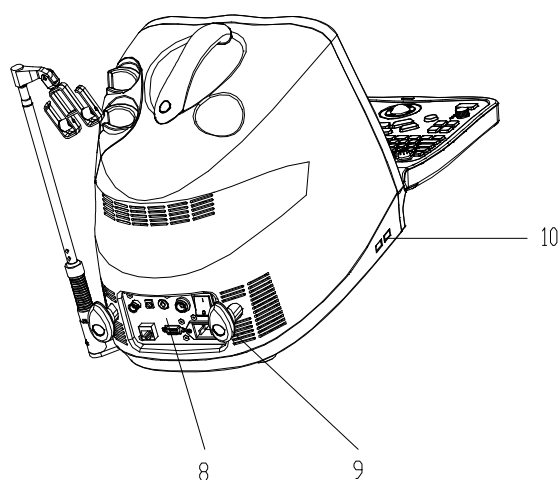


Figure 2-2 Appearance (2)

No	Name	Function
1	Control panel	Operator-system interface or control
2	Monitor	Displays the images and parameters during scanning
3	Handle	Used for carrying the system
4	Gel bottle holder	Used for holding the gel bottle provisionally
5	Probe holder	Used for holding the probe provisionally
6	Probe cable hook	Used for hanging the probe cable
7	Probe socket	Used for connecting a probe
8	I/O panel	Interface panel for input and output signal
9	Cable holder	Used for winding the IO cable provisionally
10	USB port	Used for connecting a USB device

2.1.2 Front View of Whole Machine

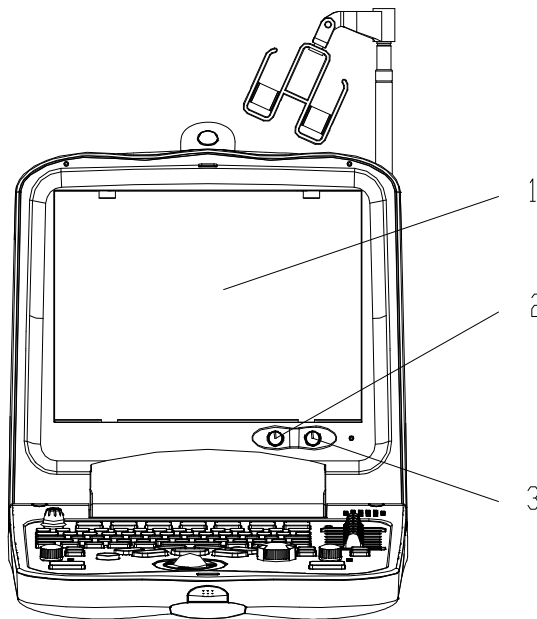


Figure 2-3 Front View of Whole Machine

No	Name	Function
1	Monitor	Displays the images and parameters etc
2	Brightness knob	Rotate it to adjust the brightness of the monitor

3	Contrast knob	Rotate it to adjust the contrast of the monitor
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2.1.3 Right View of Whole Machine

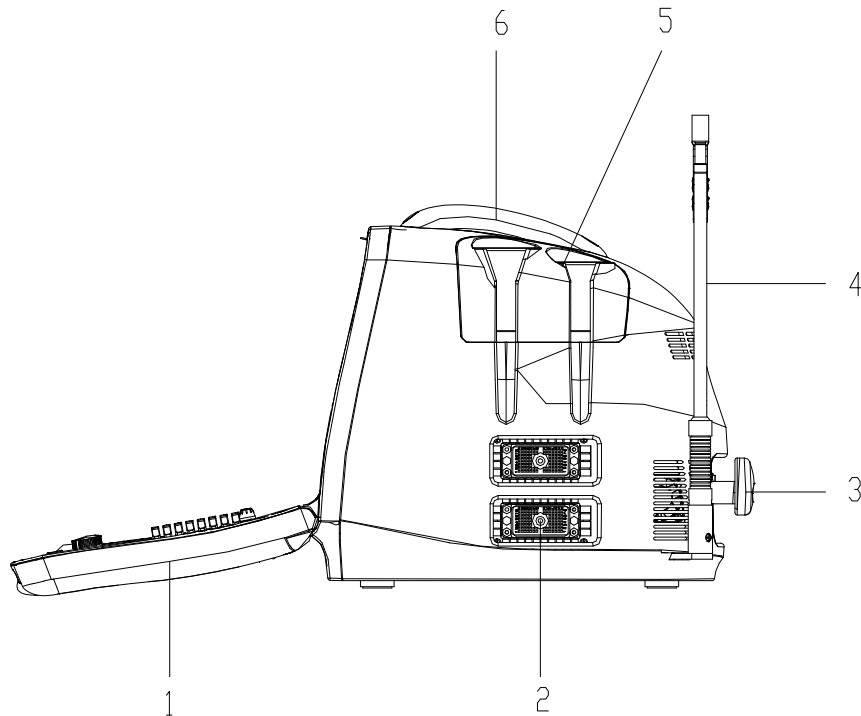


Figure 2-4 Right View of Whole Machine

No	Name	Function
1	Control panel	Used for operating the system
2	Probe socket (the standard configuration is one)	Used for connecting a probe
3	Cable holder	Used for winding the IO cable provisionally
4	Probe cable hook	Used for hanging the probe cable
5	Probe holder	Used for holding the probe
6	Handle	Used for carrying the system

2.1.4 Left View of Whole Machine

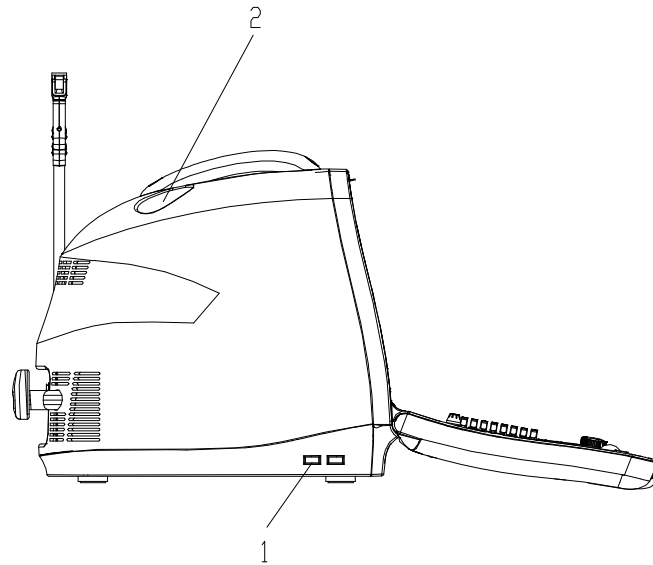


Figure 2-5 Left View of Whole Machine

No	Name	Function
1	USB port	Used for connecting a USB device
2	Gel bottle holder	Used for holding the gel bottle

2.1.5 Back View of Whole Machine

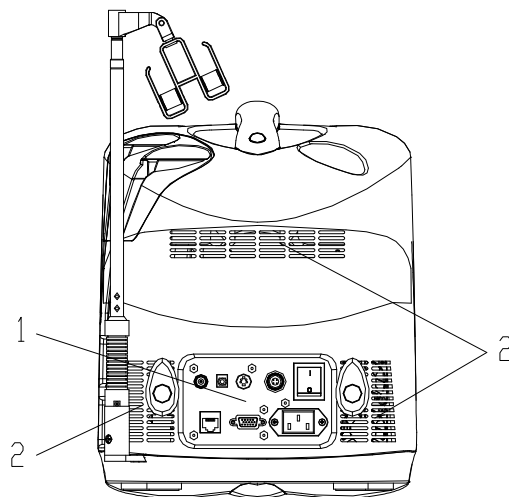


Figure 2-6 Back View of Whole Machine

No	Name	Function
1	IO interface	Input and output interface
2	Air vent	Air outlet of the system

2.2 Introduction of Control Panel

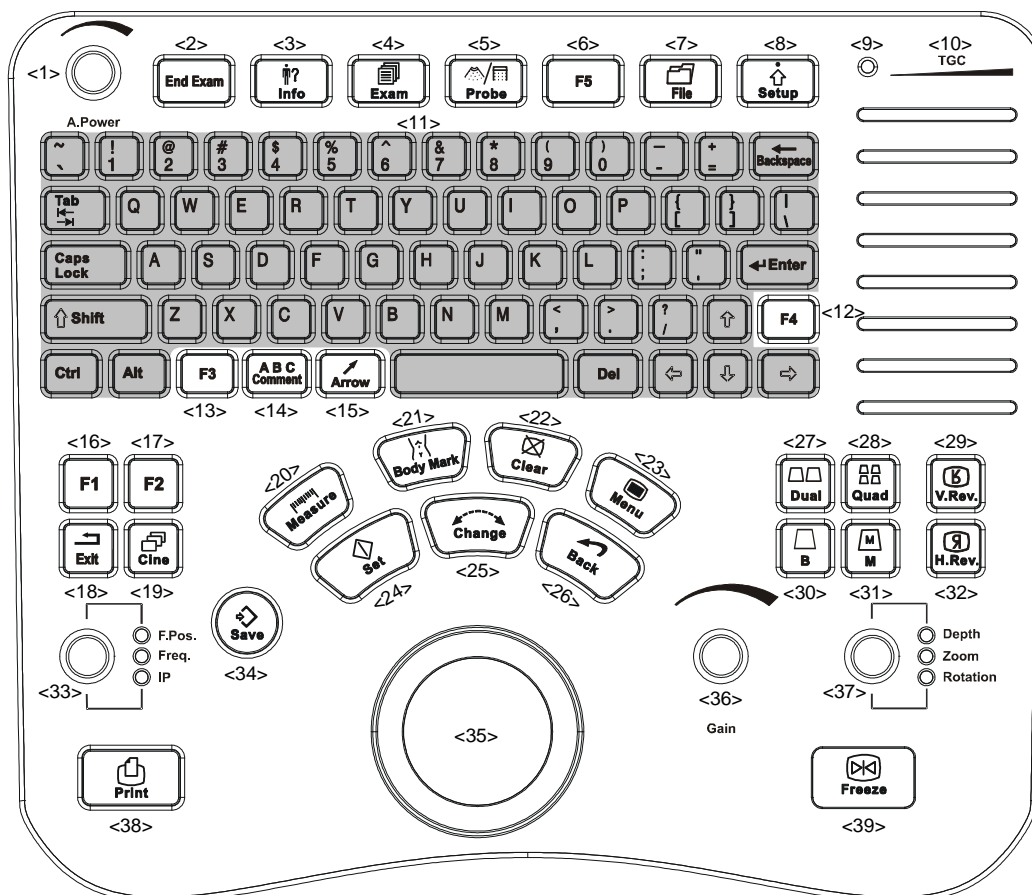


Figure 2-7 Control Panel

No.	Name	Function
1	A.Power	Adjusts the acoustic power when rotated. The function when pressed can be preset
2	End Exam	Ends the current exam
3	Info	Opens/closes the patient information dialog box
4	Exam	Opens the exam mode menu to select an exam mode
5	Probe	Switches probes
6	F5	User-defined key, the function of which can be preset
7	File	Opens iStation
8	Setup	Opens the preset menu

No.	Name	Function
9	Indicator	Reserved
10	TGC	Time Gain Compensation
11	Character & number keys	Used for inputting characters and symbols
12	F4	User-defined key, the function of which can be preset
13	F3	User-defined key, the function of which can be preset
14	Comment	Enters/exits character comment mode
15	Arrow	Enters/exits arrow comment mode
16	F1	User-defined key, the function of which can be preset
17	F2	User-defined key, the function of which can be preset
18	Exit	Exits a dialog box without saving changes
19	Cine	Switches between auto/manual cine review modes. Releases the cursor
20	Measure	Enters/exits measure mode
21	Body Mark	Adds body mark to the image
22	Clear	Clears the screen
23	Menu	Opens/closes the menu of current mode
24	Set	Selects items/Confirms an operation/Increases a parameter
25	Change	Switches among items before beginning a measurement; Switches between cursors during a measurement
26	Back	Cancels the last step when measuring/Decreases a parameter
27	Dual	Switches to dual B mode. Or Switches between windows in dual B mode
28	Quad	Switches to quad B mode. Or Switches among windows in quad B mode
29	V.Rev.	Flips the image vertically
30	B	Switches to B mode
31	M	Switches to M+B or M mode
32	H.Rev.	Flips the image horizontally

No.	Name	Function
33	Multifunctional Knob (L): F.Pos./Freq./IP	Press to switch among items and rotate to adjust the corresponding item: <ul style="list-style-type: none"> ● F.Pos.: Adjusts location of the focus ● Freq.: Switches the transmitting frequency ● IP: Adjusts the image quality according to a set of preset image parameters
34	Save	Saves an image as preset format
35	Track Ball	Moves the cursor
36	Gain	Adjusts the gain of image when rotated. The function when pressed can be preset
37	Multifunctional knob (R): Depth/Zoom/Rotation	Press to switch among items and rotate to adjust the corresponding item: <ul style="list-style-type: none"> ● Depth: Adjusts the depth ● Zoom: Magnifies the image ● Rotation: Rotates the arrow mark or the probe mark of the body mark
38	Print	Printing
39	Freeze	Freezes/unfreezes the image

2.3 Introduction of Rear I/O

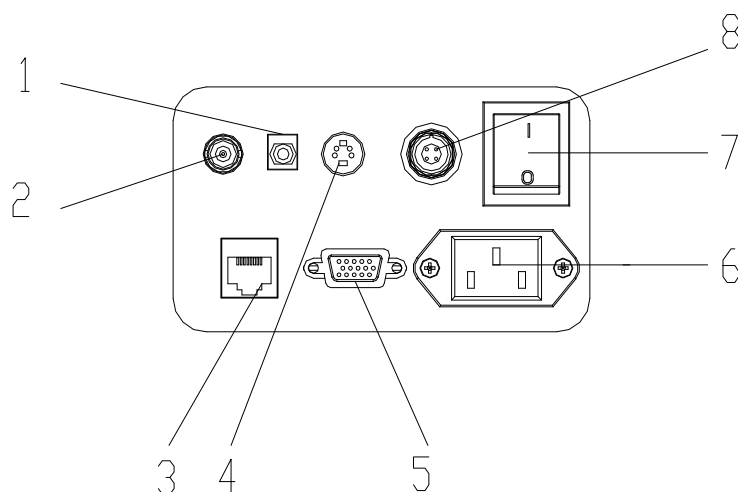








Figure 2-8 Rear I/O Ports

No.	Symbol	Function
1		Connects the remote cable of the video printer

2		Connects to the video input port of the video printer
3		Accepts the network cable
4		Connects to the video input port of the video printer
5		Connects an external monitor
6	AC IN	Accepts the power cord
7	Power switch	Power on/off
8		Accepts a foot switch

3

Principle Description

3.1 Schematic Diagram of the System

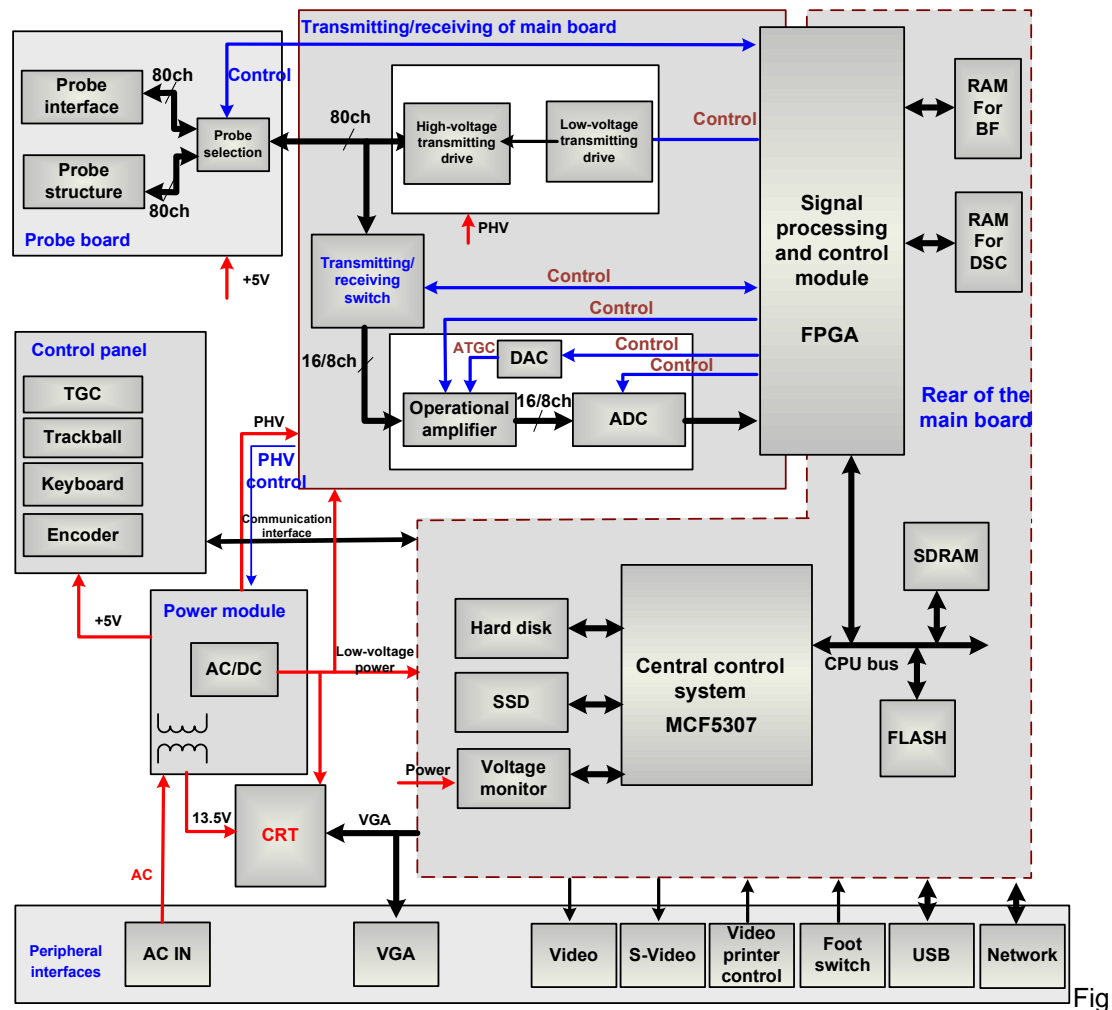


Figure 3-1 Schematic Diagram of Hardware System Structure

The above block diagram includes probe board, main board, control panel, power module, IO board and CRT etc.

- Two modules of main board: transmitting/receiving and rear of the main board comprise the key of the system. The control and processing centrum is central control system and signal processing and control module. Each function module is controlled by one of the modules or both of them.
- Power module implements the switching between AC and DC providing power for

each part of the system. For example, the monitor only needs the power of 13.5 V.

- Control panel (or called keyboard) provides operator-system interface.
- Probe board provides the socket for the probe.
- The system provides abundant interfaces: VGA, Video, S-Video, USB, network and footswitch etc.

3.2 Principle of Boards

3.2.1 Main Board

3.2.1.1 Ultrasound Transmission

The front-end circuit includes four parts according to the function: low-voltage drive and high-voltage transmitting, high-voltage isolation and channel selection, ATGC signal amplification and AD acquisition as shown in Figure3-2 below:

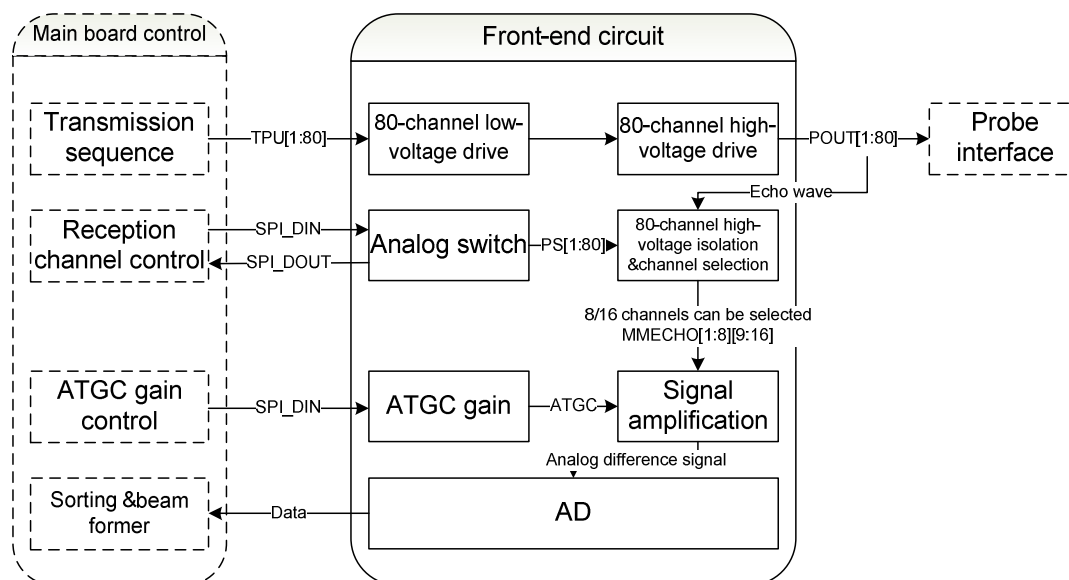


Figure 3-2 Schematic Diagram of Front-end Circuit

Transmission circuit includes two parts: transmission sequence and transmission drive. Transmission sequence generates low-voltage transmitting pulse driven by transmission, and then it turns to high-voltage transmitting pulse to drive 80 elements.

The test points related to transmission are shown in Table 3-1.

Table 3-1 Test Points Related to Transmission

No.	Test points label	Description
1	TP23	Programmable high-voltage
2	TP28	12V

3.2.1.2 Ultrasound Reception

Ultrasound reception includes three parts: high-voltage isolation and reception channel selection, voltage controlled gain amplifier and ADC. Receiving channel selection is completed by ten SPST (single-pole single-throw) cascaded. The output of DAC is analog voltage signal, it controls the amplification.

3.2.1.3 CPU and Peripharial Circuit

Structure of CPU is shown in Figure 3-3.

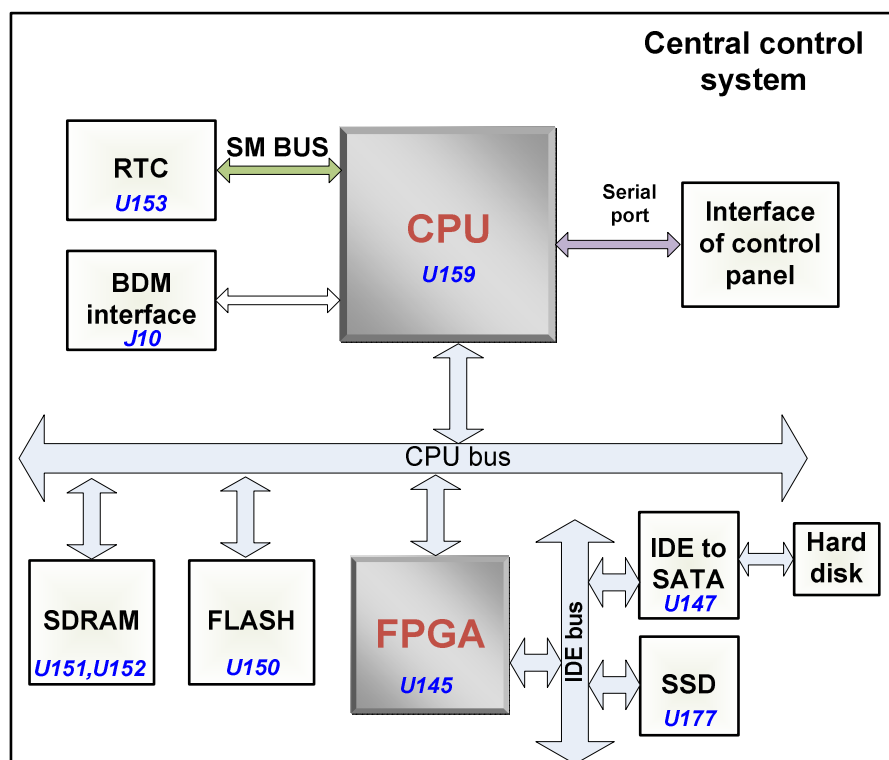


Figure 3-3 Structure of Central Control System

There are SDRAM, FLASH and FPGA on CPU bus, among which, FLASH is used for storage of system software and key data, SDRAM is used for storage of software memory and cine review, FPGA is controlled by CPU and communicates with CPU to implement the control of functional circuit. In addition, FPGA implements the interface with IDE bus and the operation of system to SSD and disc. SSD with 512MB memory capacity saves key data and remains space for user to save general data. HD with 80G is optional part; it is used for image and cine

storage.

RTC (real time clock) connects with CPU, providing time storage (year, month, day, hour, minute and second).

BDM interface is CPU debugging interface.

CPU communicates with control panel via serial port.

3.2.1.4 Interfaces of Main Board

The signal relation between peripheral interfaces of main board and probe board, IO board and connection board is shown in Figure 3-4

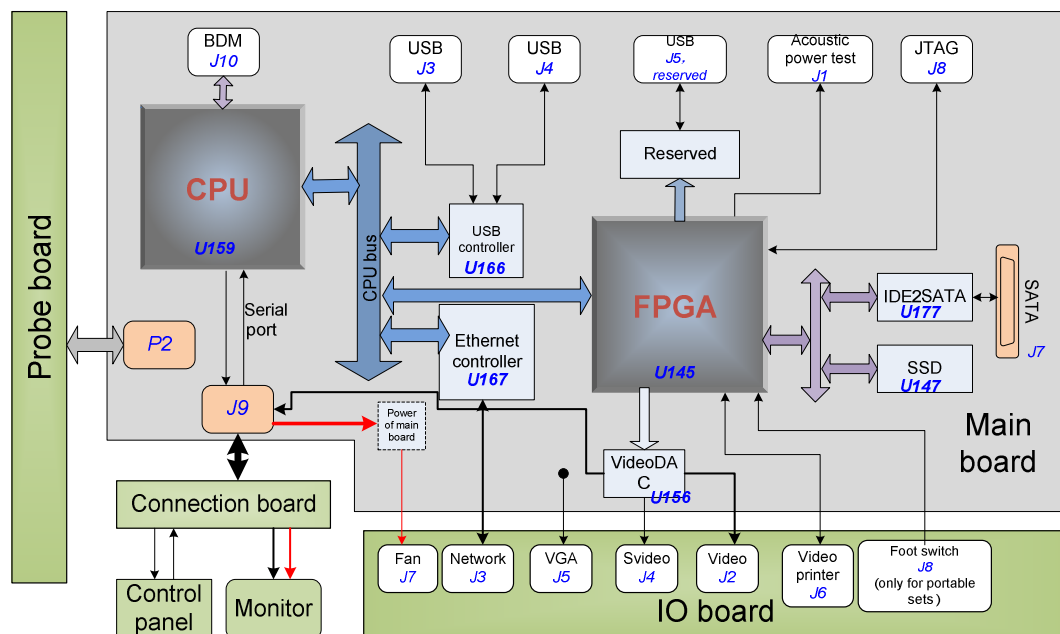


Figure 3-4 Peripheral Interfaces of Main Board and Connection Relation

- 1) The interface definition between main board and probe board needn't testing, so it will not be listed here for the reason of secrecy.
- 2) The signal description between main board and probe board is shown in Table 3-2.

Table 3-2 Signal Description between Main Board and Probe Board

Name	Function
POUT[80:1]	High-voltage transmitting and receiving
PRB_ID[5:0]	Probe identifies ID code/ID code of board
PRBID_RD[1:0]	Probe ID reading enable
PRB_SW	Probe switching (control relay switching)
PRBA_PRT_N	Probe on-site signal

PRBB_PRT_N	
VCC_PRB	Power of probe board, +5V
GND	Ground return

- 3) The interface definition between main board and connection board is shown in Table 3-3.

Table 3-3 Interface Definition between Main Board and Connection Board

Pin No.	A	B	C
1	PHV	PHV	PHV
2	NC	NC	NC
3	GND	GND	GND
4	—5V	—5V	—5V
5	GND	GND	GND
6	12V	12V	12V
7	GND	GND	GND
8	A+5V	A+5V	A+5V
9	A+5V	A+5V	A+5V
10	A+5V	A+5V	A+5V
11	GND	GND	GND
12	HVC	GND	GND
13	GND	GND	GND
14	GND	GND	GND
15	2V5	2V5	2V5
16	GND	GND	GND
17	1V5	1V5	1V5
18	1V5	1V5	1V5
19	GND	GND	GND
20	GND	GND	GND
21	3V3	3V3	3V3
22	3V3	3V3	3V3
23	GND	GND	GND
24	GND	GND	GND
25	13V5	13V5	13V5
26	VS	GND	GND
27	HS	GND	B

Pin No.	A	B	C
28	GND	GND	GND
29	TXD	GND	RXD
30	GND	GND	GND
31	D+5V	D+5V	D+5V
32	D+5V	D+5V	D+5V

- 4) The interface definition between main board and IO board is shown in Table 3-3.

Table 3-3 Interface Definition between Main Board and IO Board

Pin No.	Name	Pin No.	Name
1	VIDEO	2	GND
3	Blue_OUT_R	4	Blue_OUT_G
5	Blue_OUT_B	6	GND
7	GND	8	F_VGA_HSYNC
9	FT_SW1	10	F_VGA_VSYNC
11	FT_SW0	12	GND
13	GND	14	S_VIDEO
15	VP_BUSY	16	CI
17	VP_NPRT	18	CT7
19	GND	20	GND
21	TPIP	22	TPOP
23	TPIN	24	TPON
25	GND	26	GND
27	FAN_PWR	28	FAN_SPEED1
29	FAN_SPEED2	30	FAN_SPEED3

- 5) The signal description between main board and IO board is shown in Table 3-4.

Table 3-4 Signal Description between Main Board and IO Board

Module	Name	Description	
Video output	VIDEO	Video output	
	S_VIDEO	S_Video output	
Network port	TPOP	Output data	Difference pair
	TPON	Output data	
	TPIP	Input data	Difference pair
	TPIN	Input data	

	CT7	Tap
VGA Video output	BLUE_R	VGA signal output
	BLUE_G	
	BLUE_B	
	HSYNC	Horizontal hold
	VSYNC	Field locking
Remote	REMOTE	Video printer control
Footswitch	FT_SW0	
	FT_SW1	
Video printer	VP_NPRT	Print
	VP_BUSY	Printer is busy
Fan	FAN_PWR	Fan power
	FAN_SPEED1	Fan monitoring
	FAN_SPEED2	Fan monitoring
	FAN_SPEED3	Fan monitoring
Uncovering Inspection	CI	

3.2.1.5 Main Board Power

Main board power is connected with power supply board by connection board. All powers are processed LC filtering at the sockets of main board entrance firstly and then assigned to the devices within the board. There is fuse on main board end. The structure of main board power is shown in Figure 3-5.

Fuse F3: M07-00077F - (FUSE Slow-Blow 125V 5ASMD2410).

Fuse F1-2 and F4-9: M07-00076F - (FUSE protective tube Slow-Blow125V 3ASMD2410).

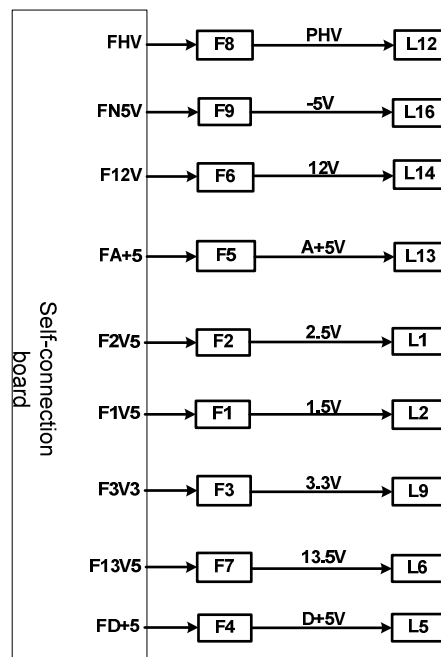


Figure 3-5 Sketch Map of Main Board Power

3.2.1.6 System Monitoring

3.2.1.6.1. Voltage Monitoring

Voltage monitoring circuit mainly monitors +1.2V, +2.5V, +3V, +3.3V, +5V, +12V, +13.5V, -1.5V, -5V and PHV (Programmable high-voltage) of the system, among which, except +5V, +12V, +3.3V, +2.5V and +1.2V, other voltages are all monitored by dividing voltage or inverting conversion. In addition to monitoring each channel voltage and internal voltage entering by connection board, IDT7462 also inspects the voltage of 3V lithium battery. Voltage monitoring is implemented by ADT7462, completely compatible with SMBus1.1 and SMBus1.0 protocols.

3.2.1.6.2. Monitoring of Fan Blockage

The fan signals used by the machine belong to R Type, in which, the third channel signal is running sensor or blockage signal.

When the fan is running, blockage signal is low (0V); when the fan is blocked, the signal is high (3.3V).

When the fan is wrongly connected, the signal is also high.

3.2.1.7 Test Points of Main Board

Test Points of main board is shown in Table 3-5:

Table 3-5 Test Points of Main Board

No.	Label	Network
1	1V2	1V2

No.	Label	Network
2	1V5	1V5
3	2V5	2V5
4	A+3	A+3
5	A+5	A+5
6	A1V8	A1V8
7	A3V3	A3V3
8	AVCC	AVCC
9	AVDD	AVDD
10	AVPP	AVPP
11	CLK45M	FPGA_CLK45_NORM
12	CLK_CPU	CPU_CLK_I
13	FPGA_RST	FPGA_RSTI
14	GND	GND
15	M13V5	13V5
16	NA1V5	NA1V5
17	NA5V	NA5V
18	PHV	PHV
19	RST_CPU	CPU_RSTI_N
20	SCL	SCL
21	SDA	SDA
22	POUT41	POUT41
23	TP1	IDE_DMAREQ
24	TP2	IDE_DMACK_N
25	TP5	SPI_5625_CLK
26	TP8	IO_RESET_N
27	TPU71	TPU71
28	TP10	IO_DQS3R_CDPCLK4
29	TP11	UAI
30	TP12	UAO
31	TP13	IDE2SATA_CLK
32	TP14	SCIDIN
33	TP15	SCICLK
34	TP16	IO_DIFFIO_DQS1R_DPCLK6

No.	Label	Network
35	TP17	SCIDOUT
36	TP18	SPI_5626_DIN
37	TP19	SPI_5626_CS
38	TP20	SPI_714_CS
39	TP21	SPI_714_CLK
40	TP22	CPU_ADDR0
41	TP24	VDD
42	TP27	GND
43	TPU75	TPU75
44	TPU79	TPU79
45	VCC	VCC

3.2.2 Probe Board

3.2.2.1 Principle of Probe Board

Standard configuration of the product is single socket probe board, but double sockets probe board is optional.

Double sockets probe board mainly includes A, B probe sockets, 80-channel selection circuit, probe and PCB-ID output circuit, relay control circuit and power circuit. Single socket probe board mainly includes probe socket, probe and PCB-ID output circuit and power circuit.

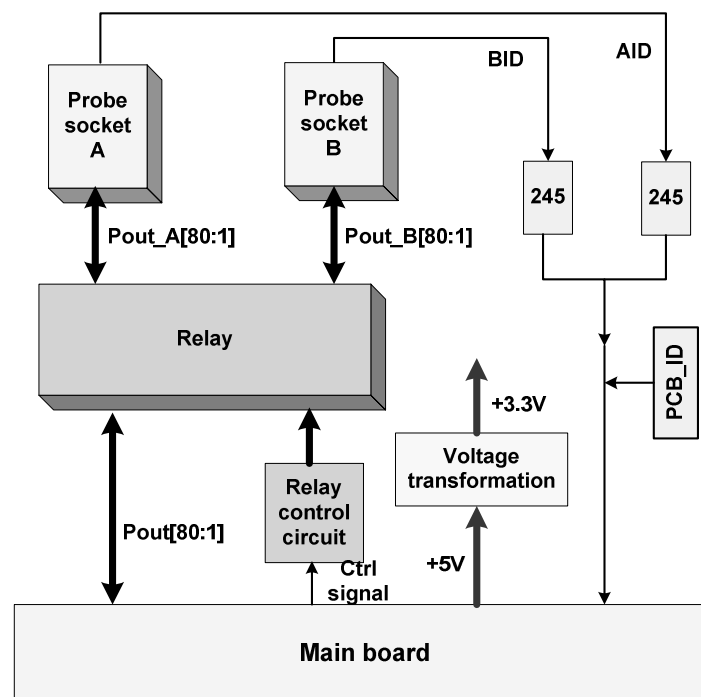


Figure 3-6 Schematic Diagram of Double Sockets Probe Board

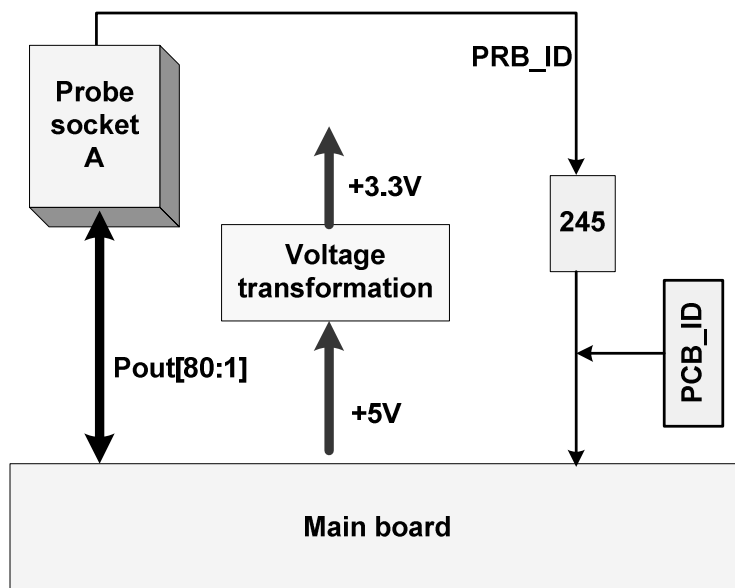


Figure 3-7 Schematic Diagram of Single Socket Probe Board

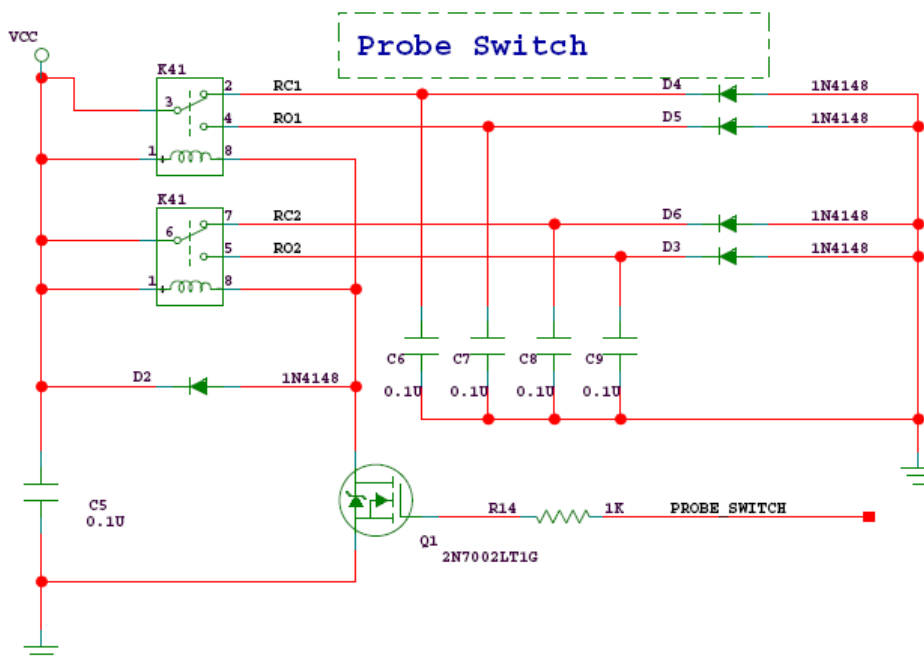


Figure 3-8 Double Sockets Probe Board Relay Drive Circuit

Control circuit connection of DPDT (double-pole double-throw relay) is shown in the above figure. Control signals are RC1, RC2, RO1 and RO2, respectively controls 10 relays, totally 40 relays and 80 channels.

- 1) When PROBE_SWITCH signal is in high electrical level, N slot enhancement-mode

field-effect transistor Q1 is conducted, and then it will drive the normally open contact of relay K41 close. RC1 and RC2 are suspended, and the normally close contacts of 20 relays under their control are closed. Now, probe A is selected.

- 2) When PROBE_SWITCH signal is in low electrical level, N slot enhancement-mode field-effect transistor 2 is not conducted, and then it will drive the normally close contact of relay K41 close. RC1 and RC2 are connected with VCC, and the normally open contacts of 20 relays under their control are closed. Now, probe B is selected.

3.2.2.2 Probe Board Interfaces

- 1) The interface signal between main board and probe board needn't testing, so it will not be listed here for the reason of secrecy.
- 2) The signal description between main board and probe board is shown in Table 3-6.

Table 3-6 Signal Description between Main Board and Probe Board

Name	Function
POUT[80:1]	High-voltage transmitting and receiving
PRB_ID[5:0]	Probe identifies ID code/ID code of board
PRBID_RD[1:0]	Probe ID reading enable
PRB_SW	Probe switching (control relay switching)
PRBA_PRT_N PRBB_PRT_N	Probe on-site signal
VCC_PRB	Power of probe board, +5V
GND	Ground return

3.2.3 Connection Board

The interface between main board and connection board is shown in Table 3-7.

Table 3-7 Interfaces between Main Board and Connection Board

No.	A	B	C
1	PHV	PHV	PHV
2	NC	NC	NC
3	GND	GND	GND
4	−5V	−5V	−5V
5	GND	GND	GND
6	12V	12V	12V
7	GND	GND	GND
8	A+5V	A+5V	A+5V

No.	A	B	C
9	A+5V	A+5V	A+5V
10	A+5V	A+5V	A+5V
11	GND	GND	GND
12	HVC	GND	GND
13	GND	GND	GND
14	GND	GND	GND
15	2V5	2V5	2V5
16	GND	GND	GND
17	1V5	1V5	1V5
18	1V5	1V5	1V5
19	GND	GND	GND
20	GND	GND	GND
21	3V3	3V3	3V3
22	3V3	3V3	3V3
23	GND	GND	GND
24	GND	GND	GND
25	13V5	13V5	13V5
26	NC	GND	GND
27	NC	GND	NC
28	GND	GND	GND
29	NC	GND	NC
30	GND	GND	GND
31	D+5V	D+5V	D+5V
32	D+5V	D+5V	D+5V

The ports communication signal with 3.3 V LVTTTL level between keyboard and main board is transferred via connection board. +5V power supply of keyboard is from D+5 of connection board. Connection board provides an 8 pin socket; the definition is shown in Table 3-8.

Table 3-8 Interface Definition of Keyboard

No.	Name	Description
1	RXD	Data input of main board ports
2	GND	Ground
3	TXD	Data output of main board ports
4	GND	Ground

5	GND	Ground
6	GND	Ground
7	D+5	D+5V power
8	D+5	D+5V power

The signals main board sending to monitor are transferred via connection board. +13.5V power supply is from 13V5 of connection board. Connection board provides a 6 pin socket and a 4 pin socket; the interface definition of monitor signals is shown in Table 3-9.

Table 3-9 Interface Definition of Monitor Signals

No.	Name	Description
1	GND	Signal ground
2	HS	Horizontal hold signal
3	GND	Signal ground
4	VS	Field locking
5	GND	Signal ground
6	B	BLUE signal

The interface definition of monitor power is shown in Table 3-10.

Table 3-10 Interface Definition of Monitor Power

No.	Name	Description
1	GND	Power ground
2	GND	Power ground
3	13V5	+13.5V power
4	13V5	+13.5V power

3.2.4 IO Board

IO board is fixed on sheet-metal. Except USB port is on the side of the device, footswitch socket is on the sheet-metal at the back of the device; all other external IO interfaces (Video, S-Video, VGA, Remote and network) are on IO board.

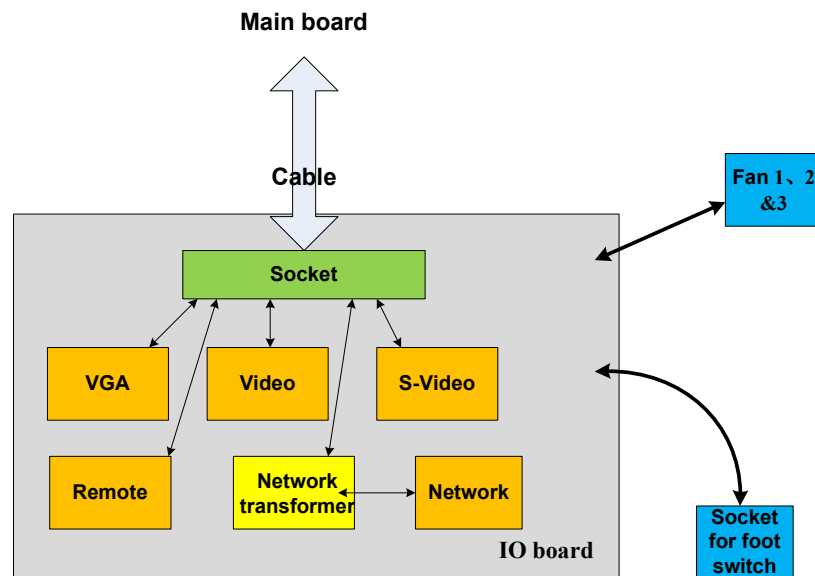


Figure 3-9 Sketch Map of IO Board Connection Relation

IO board is connected with main board by wires. The interface definition is shown in Table 3-11.

Table 3-11 Interface Definition between Main Board and IO Board

No.	Name	No.	Name
1	VIDEO	2	GND
3	Blue_OUT_R	4	Blue_OUT_G
5	Blue_OUT_B	6	GND
7	GND	8	F_VGA_HSYNC
9	FT_SW1	10	F_VGA_VSYNC
11	FT_SW0	12	GND
13	GND	14	S_VIDEO
15	VP_BUSY	16	CI
17	VP_NPRT	18	CT7
19	GND	20	GND
21	TPIP	22	TPOP
23	TPIN	24	TPON
25	GND	26	GND
27	FAN_PWR	28	FAN_SPEED1
29	FAN_SPEED2	30	FAN_SPEED3

The signal definition of connection socket of footswitch cable is shown in Table 3-12.

Table 3-12 Signal Definition of Connection Socket of Footswitch Cable

No.	Name
1	ROW
3	FT_SW0
5	FT_SW1
7	GND

3.2.5 Control Panel Module

The peripheral of control panel mainly includes encoder, thin-film switch, trackball, LED, speaker and TGC etc. The schematic diagram of control panel is shown in

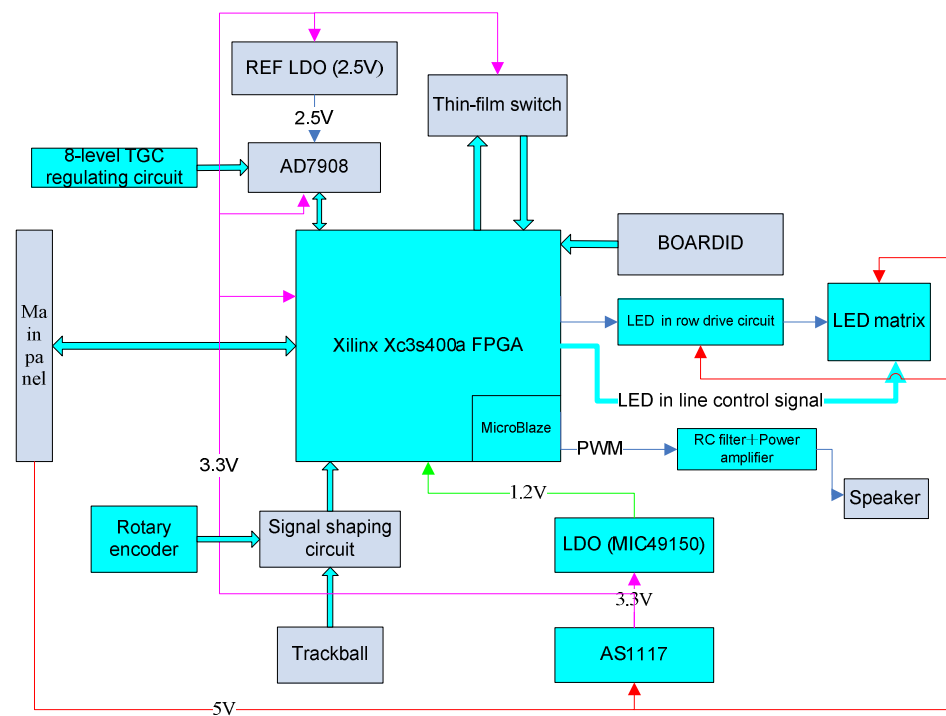


Figure 3-10.

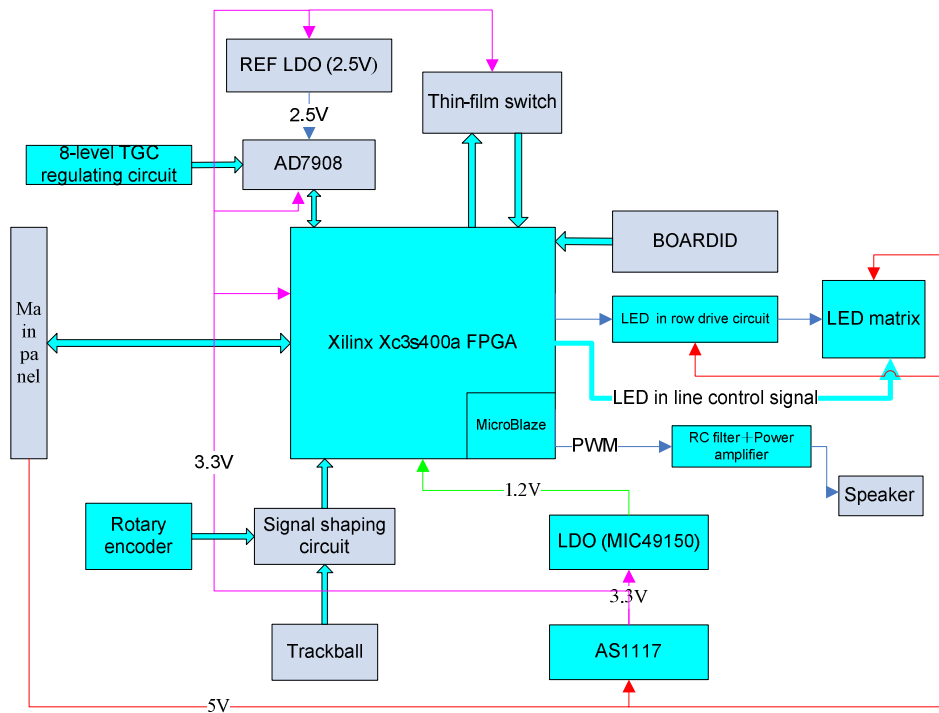


Figure 3-10 Schematic Diagram of Control Panel

3.2.5.1 Description of LED Drive Circuit

Just as shown in Figure 3-11, LED includes green backlighting lights and yellow indicating lights. It only needs backlighting lights with unicolor LED for common keys. While, function keys adopts bicolor LED in green and yellow, which means backlighting lights and indicating lights are both needed.

The anode of all unicolor and bicolor LEDs is the same one. LED_ROW signal output from FPGA will go through LED drive circuit that is composed of MOS tube EL7212 and PMOS tube IRF7404 to output LED_DRIVE signal to drive LED. For common keys, the cathode of unicolor LED is directly grounded with 750hm current-limiting resistance. For function keys, each two bicolor LEDs are driven by 74LS07 via two pins of FPGA to achieve the purpose that switching between backlighting lights and indicating lights.

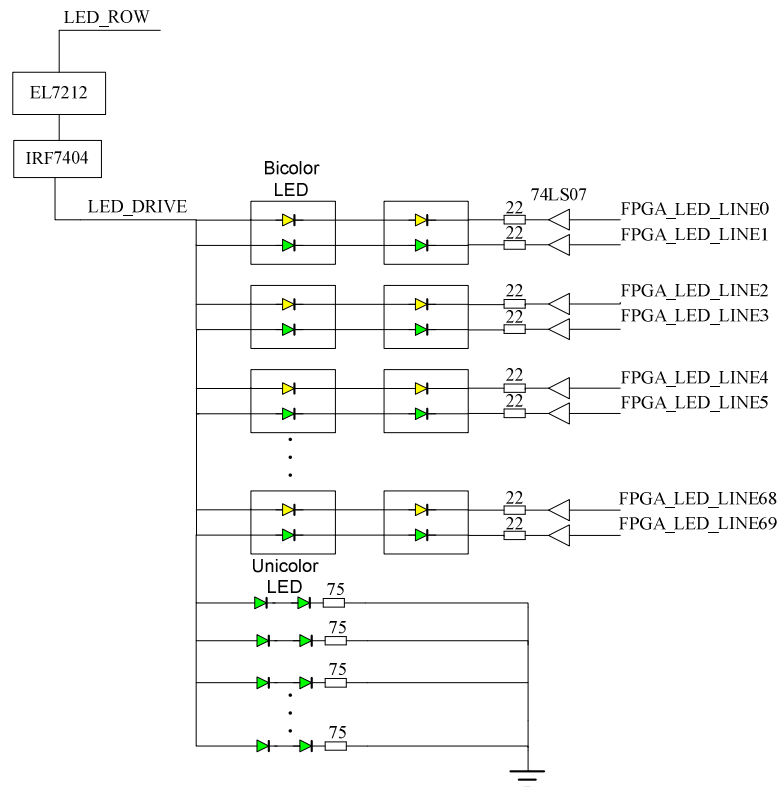


Figure 3-11 Schematic Diagram of LED Drive Circuit

3.2.5.2 Description of Key Scanning Circuit

The key matrix adopts the signal in row and line control method. Testing signal will be output from FPGA line by line. When press a certain key, the signal in row will be corresponding to a signal in line. The location of the pressed key can be known from sequence number of row and line. The schematic diagram of key scanning is shown in Figure 3-12.

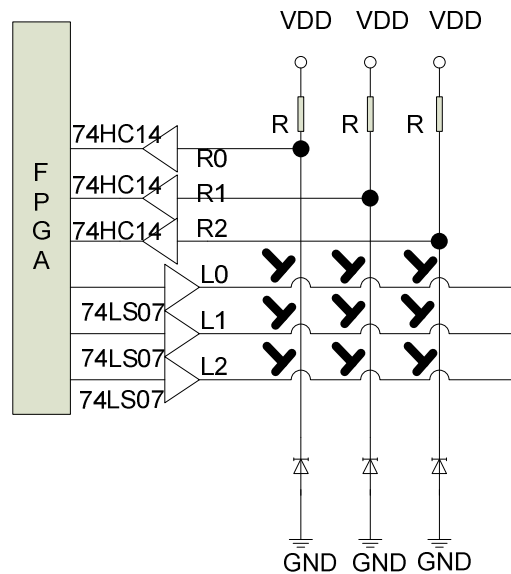


Figure 3-12 Schematic Diagram of Key Scanning

Thin-film switch adopts the three layers implementation method of upper wiring film, lower wiring film and middle insulation film. The middle insulation film takes the function of separation and opens a hole at key contact. The upper and lower wiring film form two poles at key contact. When pressing the key, the up and down poles are conducted. When the key is unpressed, for the separation of middle insulation film, the up and down poles are unconnected.

3.2.5.3 Description of Speaker Drive Circuit

The keyboard board adopts the project of PWM plus RC Ffilter and speaker acoustics. The sketch map of speaker drive method is shown in Figure 3-13.

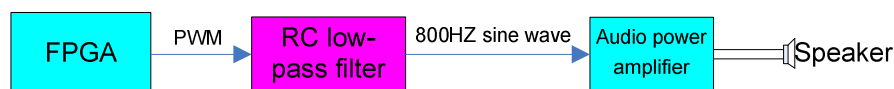


Figure 3-13 Sketch Map of Speaker Drive Method

3.2.5.4 Socket Definition

The socket definition of control pane is shown in Table 3-13.

Table 3-13 Socket Definition of Control Panel

Socket number on PCB	Name	Pin definition			Remarks
		Pin No	Pin definition	Pin description	

J5	Socket of keyboard and connection board	1	+5V	5V power		
		2	+5V	5V power		
		3	GND	System ground		
		4	RXD_KEY_IN	Main unit serial port signal output		
		5	GND	System ground		
		6	TXD_KEY_OUT	Main unit serial port signal input		
J3	Trackball socket	1	GND	System ground		
		2	VCC	5V power		
		3	TRACK_HBALL0	Trackball signal interface 0		
		4	TRACK_HBALL1	Trackball signal interface 1		
		5	TRACK_HBALL2	Trackball signal interface 2		
		6	TRACK_HBALL3	Trackball signal interface 3		
J2	Socket definition of thin-film switch upper wiring	1	NC	2	NC	FKEY_ROW: key scanning signal in row NC: connectionless
		3	FKEY_ROW13	4	NC	
		5	FKEY_ROW12	6	NC	
		7	FKEY_ROW11	8	NC	
		9	FKEY_ROW10	10	NC	
		11	FKEY_ROW9	12	NC	
		13	FKEY_ROW8	14	NC	
		15	FKEY_ROW7	16	NC	
		17	FKEY_ROW6	18	NC	
		19	FKEY_ROW5	20	NC	
		21	FKEY_ROW4	22	NC	
		23	FKEY_ROW3	24	NC	
		25	FKEY_ROW2	26	NC	

		27	FKEY_ROW1	28	NC	
		29	FKEY_ROW0	30	NC	
J6	Socket definition of thin-film switch lower wiring	1	NC	2	KEY_LINE3	KEY_LINE: key scanning signal in line NC: connectionless
		3	NC	4	KEY_LINE2	
		5	NC	6	KEY_LINE1	
		7	NC	8	KEY_LINE0	
		9	NC	10	KEY_LINE4	
		11	NC	12	KEY_LINE5	
		13	NC	14	KEY_LINE6	
		15	NC	16	KEY_LINE7	
		17	NC	18	NC	
		19	NC	20	NC	
		21	NC	22	NC	
		23	NC	24	NC	
		25	NC	26	NC	
		27	NC	28	NC	
		29	NC	30	NC	
J4	JTAG socket definition	1	TCK	JTAG clock		
		2	TDO	JTAG data output		
		3	TMS	JTAG TMS		
		4	TDI	JTAG data input		
		5	VDD	VDD voltage		
		6	GND	System ground		
J8	Speaker socket	1	BUZ0	Speaker positive end input		
		2	BUZ1	Speaker negative end input		

3.2.6 Power Supply Board

3.2.6.1 Overview

Power system is the power supply for whole ultrasonic diagnostic system. It mainly supplies

the system with +5V (D+5V and A+5V), -5V, +12V, +13.5V, +3.3V, +1.5V, +2.5V and programmable high-voltage, totally 9 groups DC output.

The performance index of each output is shown in Table 3-14.

Table 3-14 Performance Index of Power Supply Board Output

No.	Rating voltage (V)	Voltage accuracy	Rating load	Minimal load	Voltage regulation rate	Load regulation rate	Ripple noise (mV _{pk-pk})	Use
1	A+5V	±5%	3A	0.5A	<2%	<5%	<30mV	Analog part/keyboard
2	D+5V		3.5A	1.0A				Keyboard/USB
3	-5.0V		0.4A	20mA				Amplifier
4	+13.5V		1.5A	0.3A			<50mV	VGA
5	+12V		0.35A	100mA				Fan /CMOS drive
6	HV		50mA	0				Transmitting circuit
7	+3.3V		3.5A	0.2A			<30mV	Digital part
8	+2.5V		1.0A	0.2A				Digital part
9	+1.5V		2.0A	0.2A				Digital part

3.2.6.2 Principle

The schematic diagram of power supply board is shown in Figure 3-14.

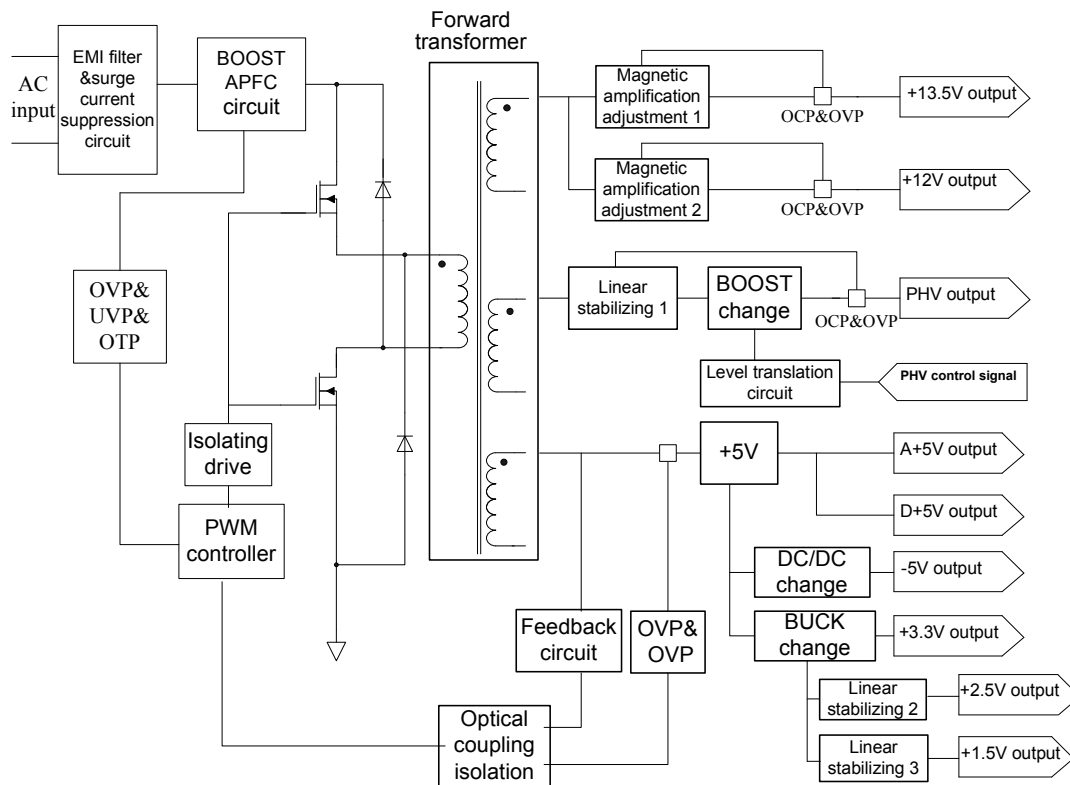


Figure 3-14 Schematic Diagram of Power Supply Board

Just as shown in the above figure, power supply board includes four parts: input part, PFC front end, FORWARD transformer and inferior DC-AC circuit.

- AC input firstly goes through EMI filter and surge current suppression circuit, and then it is regulated by BOOST APFC for power factor, simultaneously it outputs steady 390V DC power as the input of inferior FORWARD transformer. The FORWARD transformer which can output +5V, -5V, +13.5V and +24V, among which, +24V is the input of programmable high-voltage PHV, +13.5V is dropped to +12V via two diodes, while +5V is diverted to A+5V and D+5V as the input of +3.3V, +1.5V etc. DC-AC transformer, at last, +3.3V is regulated to +2.5V via linear stabilizing.
- PFC circuit adopts UC3845 produced by TI Company as control chip, and is BOOST transformer based on mean current mode controlling with excellent and reliable performance. In addition, switching tube adopts IRFPC60LC produced by IR with the parameter of 600V/16A and fly-wheel tube adopts ISL9RL1560G2 produced by FAIRCHILD with the parameter of 600V/15A.
- The controlling chip U3 of FORWARD is MB3769A produced by FUJITSU, which is a controlling chip of voltage type. Transformer T1 also meets the requirements of safety insulation. Switching tube adopts 2SK2485 produced by NEC with the parameter of 900V/6A. The main feedback output of FORWARD transformer is +5V,

while +13.5V is exactly regulated via magnetic amplifier, -5V output is regulated via LM337 linear stabilizing.

- HV output is obtained by BOOST transformer. Controlling chip is TL594 produced by ON-SEMI, which is a controlling chip of voltage type. HV output voltage is controlled by 0~4V analog signals and changed linearly corresponding to the change of controlling signals.

+3.3V and +1.5V output adopts BUCK variator based on synchronous rectification with high efficiency and reliability. Controller adopts EL7566 produced by INTERSIL, which is a device integrating controlling chip and on-off device as a whole. +3.3V output is turned to +2.5V after linear stabilizing, which is implemented by discrete devices with the merit of low voltage difference.

The power supply board has the following protection functions: PFC output overvoltage protection, overtemperature protection, +5V output overvoltage/overcurrent/short circuit protection, +13.5V output overvoltage/overcurrent/short circuit protection, HV output overvoltage /overcurrent /short circuit protection, and short circuit protection function of all other output groups. The responses of the board after each protection taking effect are as follows:

1. When PFC output overvoltage protection, overtemperature protection or +5V output overvoltage/overcurrent/short circuit protection take effect, the power supply board will stop all output and maintain locking. Only when AC input is off and the malfunction is corrected, the board can normally work after its restarting.
2. When +13.5V output overvoltage/overcurrent/short circuit protection takes effect, +13.5V and HV will stop output and maintain locking. After the malfunction is corrected and all loads of +13.5V output are disconnected, the board can output normally.
3. When +3.3V short circuit protection takes effect, +3.3V and HV will stop output. After the malfunction is corrected, the output can be recovered automatically.
4. When HV output overvoltage /overcurrent /short circuit protection, -5V overcurrent /short circuit protection, +1.5V short circuit protection or +2.5V overcurrent /short circuit protection take effect, each group will stop its output and won't affect other output. Except HV maintains locking, other groups will be recovered after the malfunction is corrected.

4 System Structure and Assembly / Disassembly

4.1 Exploded View

4.1.1 Overall Exploded View

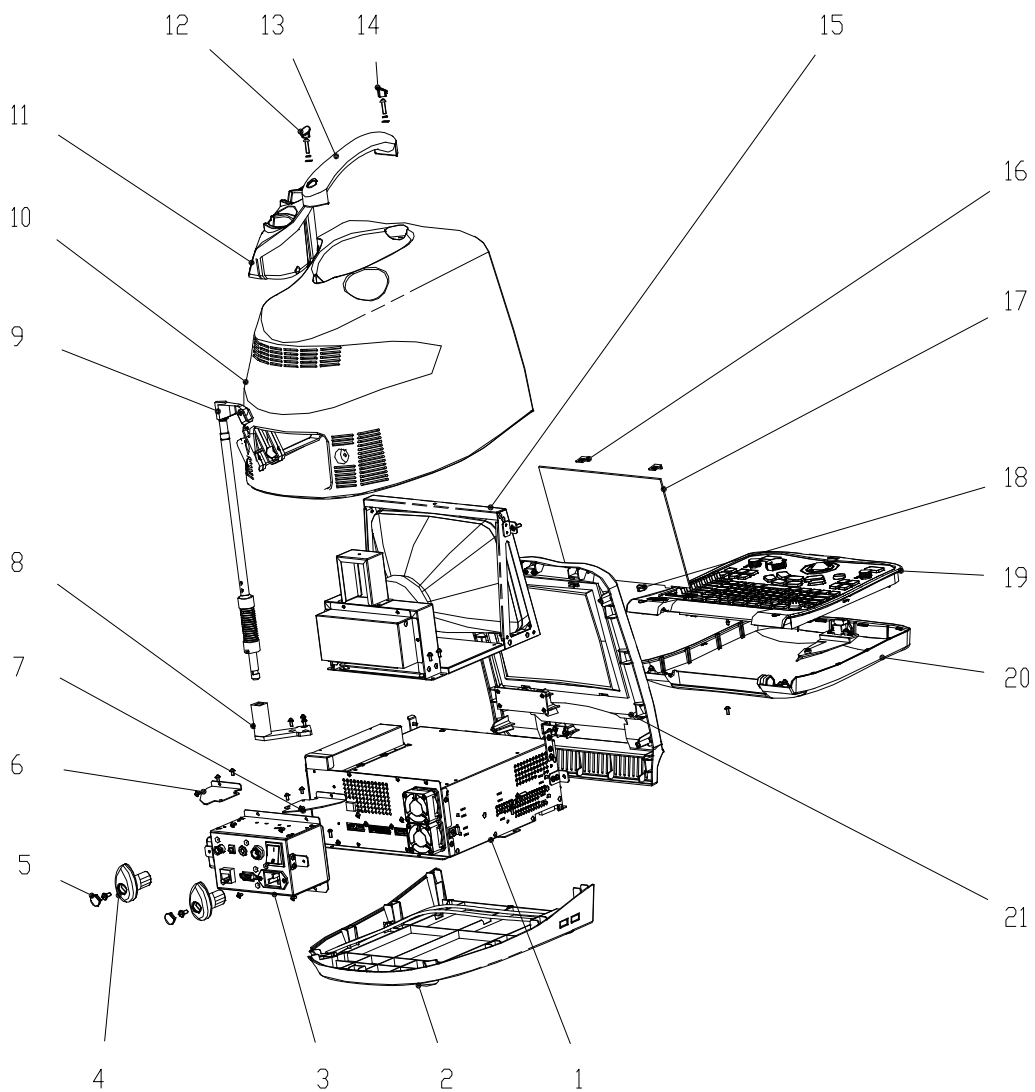


Figure 4-1 Overall Exploded View

No.	Name	PN number
1	Main unit box module (one probe)	2303-30-89069
	Main unit box module (two probes)	2303-30-89068
	Main unit box module (one probe)	2304-30-89227
	Main unit box module (two probes)	2304-30-89217
2	Bottom cover	2303-30-89063
	Bottom cover	2304-30-89218
3	IO module	2304-30-89219
4	Winding rack (die MR29064)	2300-20-29083
5	Rubber cap of winding rack (die MR29076)	0026-30-89585
6	Right wind guard	2300-20-29113
7	Left wind guard	2304-20-89266
8	Hook seat	2300-20-29085
9	Probe cable hook	2102-30-16949
10	Top cover (die MR29079)	2300-20-29079-51
11	Probe holder (die MR29082)	2300-20-29082
12	Rubber cap of handle B (pearl blue)	2300-20-29090-52
	Rubber cap of handle B (dark gray)	2300-20-29090-51
13	4900 handle (die MR29081)	2300-20-29081-53
	6900 handle (die MR29081)	2300-20-29081-54
	SK-40 handle (die MR29081)	043-002045-00
14	Rubber cap of handle A (pearl blue)	2300-20-29089-52
	Rubber cap of handle A (dark gray)	2300-20-29089-51
15	CRT assembly	2300-20-29149
16	Fixing buckle of protection screen (die BS2001138)	9901-20-23950
17	Protection screen of monitor (4900)	2302-20-34425
	10" protection screen of monitor (6900)	2107-20-46070
18	Silicon rubber cap of keyboard (die MR29076)	2300-20-29076
19	Top cover keyboard assembly	2303-30-89065
	Top cover keyboard assembly	2304-30-89221
20	Bottom cover keyboard assembly	2303-30-89064

	Bottom cover keyboard assembly	2304-30-89220
21	Front cover module	2303-30-89062
	Front cover module	2304-30-89228

4.1.2 Exploded View of Keyboard Module

4.1.2.1 Exploded View of Top Cover Keyboard Assembly

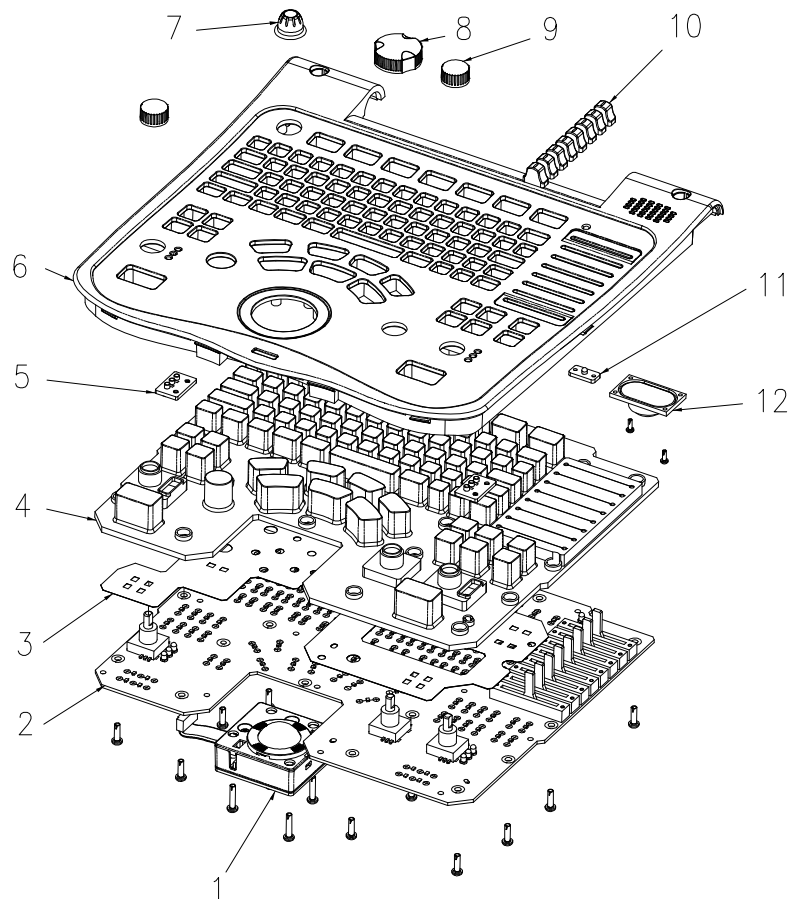


Figure 4-2 Exploded View of Top cover Keyboard Assembly

No.	Name	PN number
1	1" trackball (TP1W0)	0025-30-36802
2	Control panel PCBA	051-000183-00
3	Thin-film switch	2304-20-89283
4	DP-4900 silicon rubber key	049-000041-00
	DP-6900 silicon rubber key	049-000040-00
5	Transparent lamp shade A (die MR29069)	2300-20-29069

6	DP-6900 keyboard top cover	2304-20-89237-51
	SK-40 keyboard top cover	C-043-002035-00
7	Keyboard knob C (die MR29071)	2300-20-29073
8	Keyboard knob A(die MR29071)	2300-20-29071
9	Keyboard knob B(die MR29071)	2300-20-29072
10	Keyboard toggle switch (die MR29074)	2300-20-29074
11	Transparent lamp shade B(die MR29069)	2300-20-29070
12	SPEAKER 8 ohm 15% 1.0W SPL 86	M90-100123---

4.1.2.2 Exploded View of Bottom cover keyboard assembly

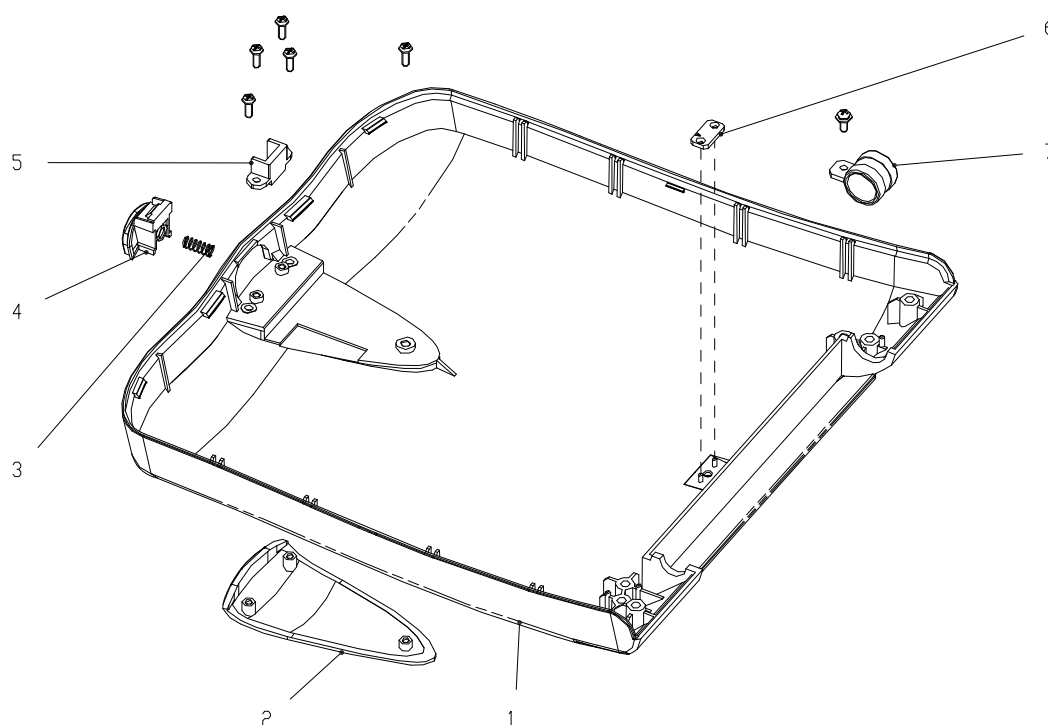


Figure 4-3 Exploded View of Bottom Cover Keyboard Assembly

No.	Name	PN number
1	Bottom cover of keyboard (die MR29062)	2300-20-29062
2	DP-4900 decorative cover	2300-20-29063-56
	DP-6900 decorative cover	2300-20-29063-57
	SK-40 decorative cover	C-043-002034-00
3	Setting bolt spring	2300-20-29065
4	Key buckle (die MR29064)	2300-20-29064
5	Spacing piece (die MR29064)	2300-20-29066

6	Transparent lamp shade B (die MR29069)	2300-20-29070
7	Hollow shafting	2300-20-29067

4.1.3 Exploded View of Main Unit Box Module

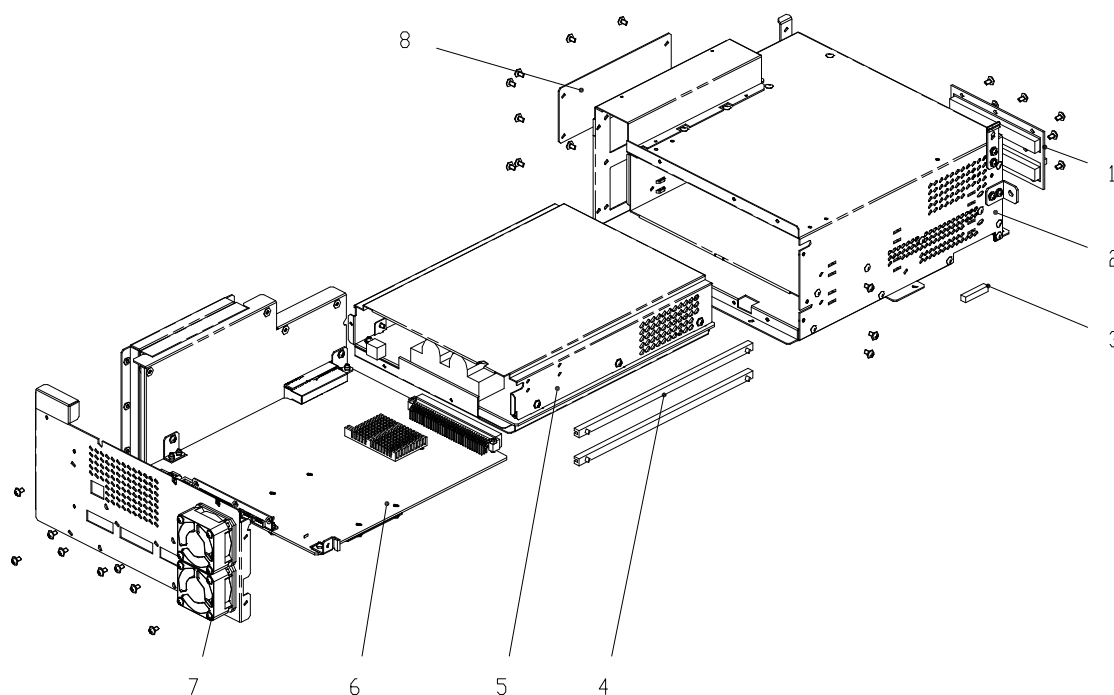


Figure 4-4 Exploded View of Main Unit Box Module

No.	Name	PN number
1	Connection board	2300-30-29053
2	Main unit box	2304-20-89206
3	Conduction foam 0501080	9901-10-23920
4	Guide slot CG-19A plastic	M90-000115---
5	Power supply board module	2304-30-89243
6	Main board and probe board modules (one probe)	2303-30-89067
	Main board and probe board modules (for two probes)	2303-30-89066
	Main board and probe board modules (for one probe)	2304-30-89225
	Main board and probe board modules	2304-30-89223

	(for two probes)	
7	Back cover module of main unit box	2304-30-89222
8	Sealing board of probe socket	2302-20-34448

If two probes are selected, there is no part 8 (sealing board of probe socket), part 6 will be changed to main board and probe board modules (for two probes).

4.2 Structure Disassembly

4.2.1 Disassemble Top Cover

- 1) Disassemble the probe cable hook.

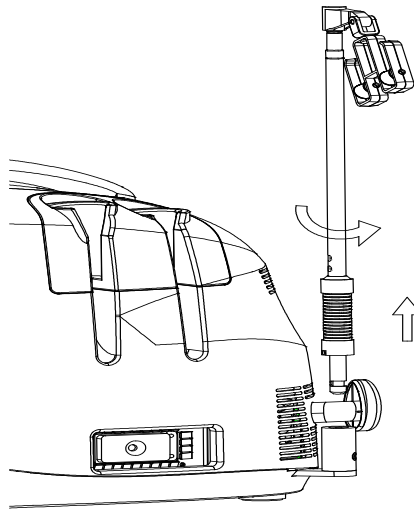


Figure 4-5 Sketch Map of Top Cover Disassembly

- a) Rotate the probe cable hook clockwise to its end.
 - b) Remove the hook upwards.
- 2) Disassemble the handle and winding rack.

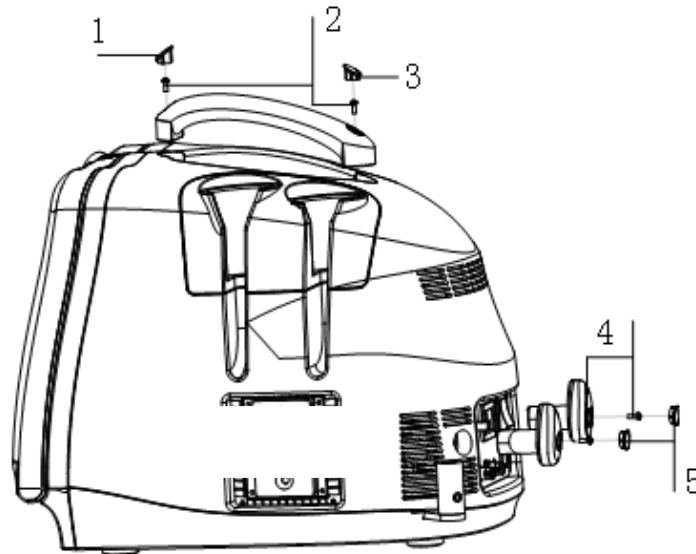


Figure 4-6 Sketch Map of Handle and Winding Rack Disassembly

No.	Name	PN number
1	Rubber cap of handle A (peral blue)	2300-20-29089-52
	Rubber cap of handle A (dark gray)	2300-20-29089-51
2	Philips pan head screw GB/T818-2000 M4X16 antirust nickel plating	M04-002905---
3	Rubber cap of handle B (peral blue)	2300-20-29090-52
	Rubber cap of handle B (dark gray)	2300-20-29090-51
4	Philips small pan head screw combination GB/T9074.8 M4X12 antirust nickel plating	M04-051139---
5	Rubber cap of winding rack (die MR29076)	2300-20-29088

- c) Pull out rubber cap A, B and rubber cap of winding rack.
 - d) Remove two M4x16 screws which are used to secure the handle, and then remove the handle.
 - e) Remove M4x12 screw which is used to secure the winding rack, and then remove the rack.
- 3) Disassemble the top cover.

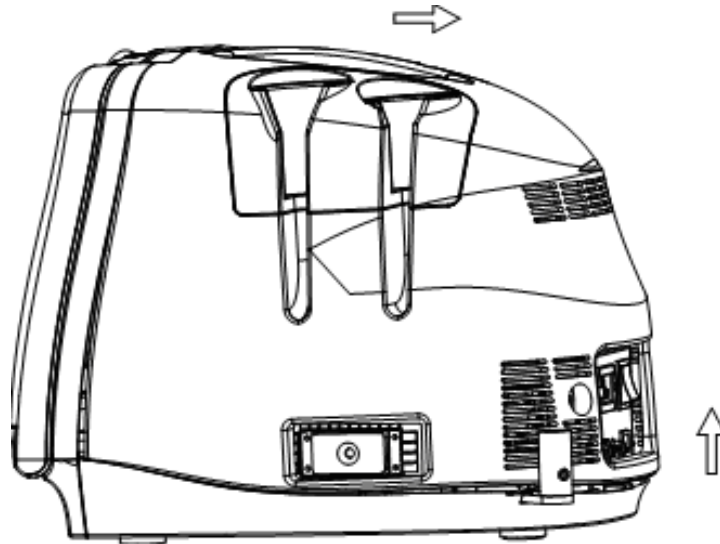


Figure 4-7 Sketch Map of Top Cover Disassembly

- f) Lift the rear of top cover upwards with force.
- g) Move back cover backwards and remove it.

4.2.2 Disassemble IO Back Cover

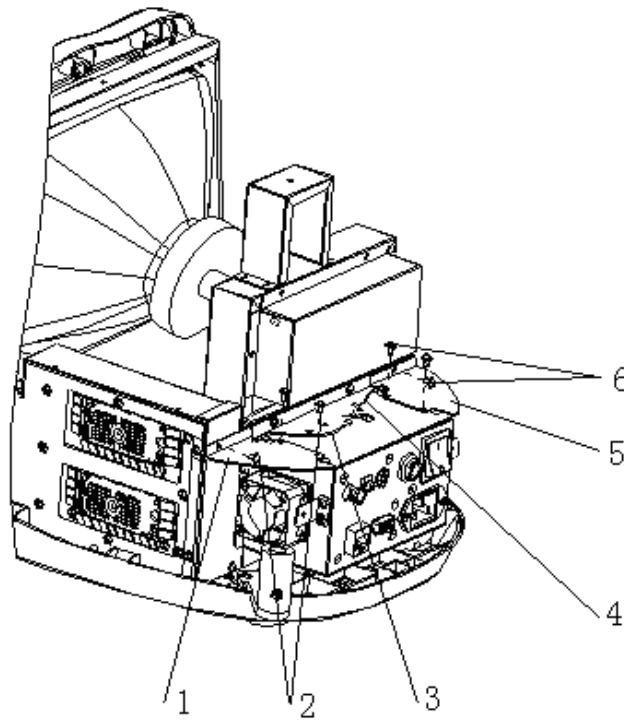


Figure 4-8 IO Back Cover Disassembly (1)

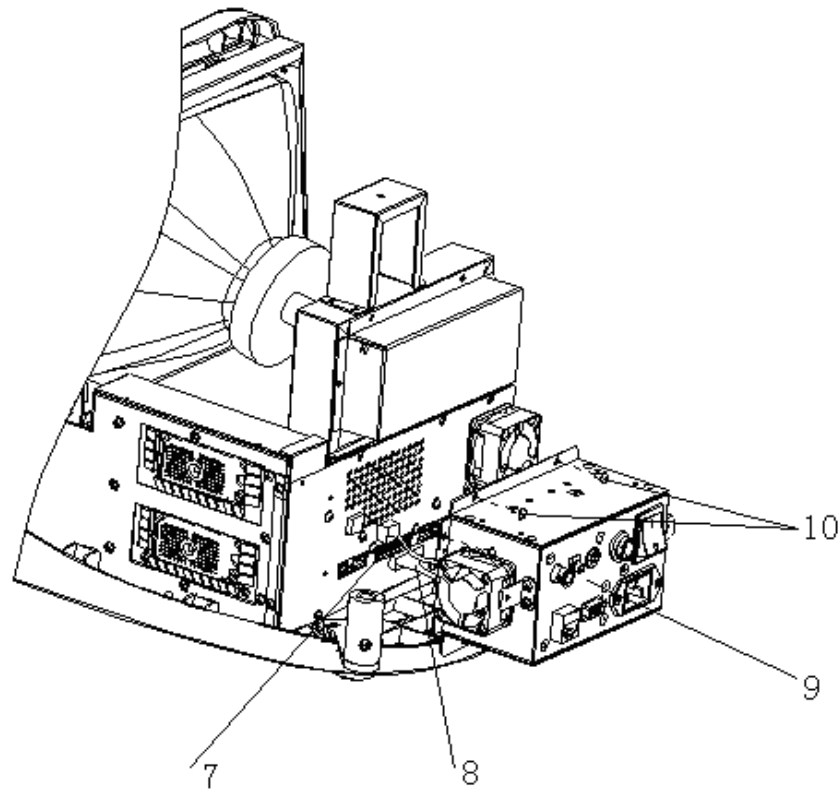


Figure 4-9 IO Back Cover Disassembly (2)

No.	Name	PN number
1	Right wind guard	2300-20-29113
2	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
3, 4	Fan connection wire	2303-20-89056
5	Left wind guard	2304-20-89266
6	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
7	Power input wire	2303-20-89053
8	Connection wire between main board and I/O board	2303-20-89057
9	IO back cover (2304)	2304-20-89208-51
10	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---

- 1) Implementing the procedure in 4.2.1, remove back cover.
- 2) Disassemble the tie of fan wire.
- 3) Remove three M3X6 screws of left wind guard and those of right wind guard respectively, and then remove the wind guards.

- 4) Remove six M3X6 screws of IO back cover module.
- 5) Disassemble the ties of power wire and IO wire, and then move backwards IO back cover to remove it.

4.2.3 Disassemble and Replace IO Board

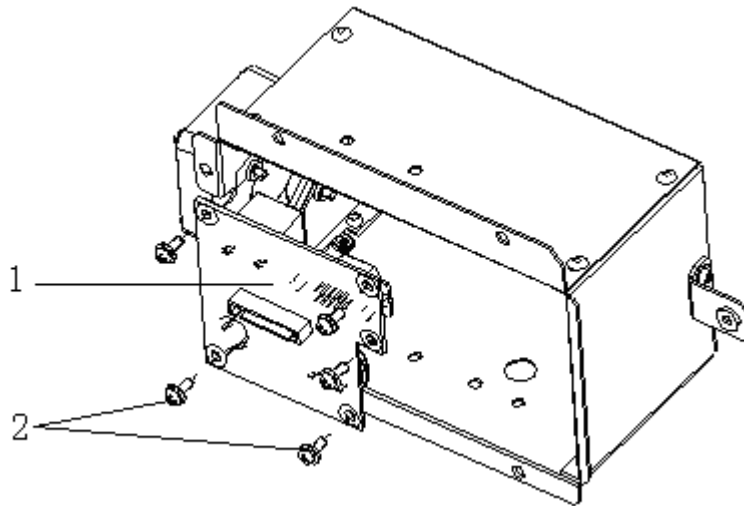


Figure 4-10 Sketch Map of IO Board Disassembly

No.	Name	PN number
1	IO board PCBA	2304-30-89205
2	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---

- 1) Implementing the procedure in 4.2.2 Disassemble IO Back Cover, remove IO back cover module.
- 2) Remove five M3X6 screws which are used to secure IO board can replace it.

4.2.4 Disassemble Back Cover of Main Unit Box

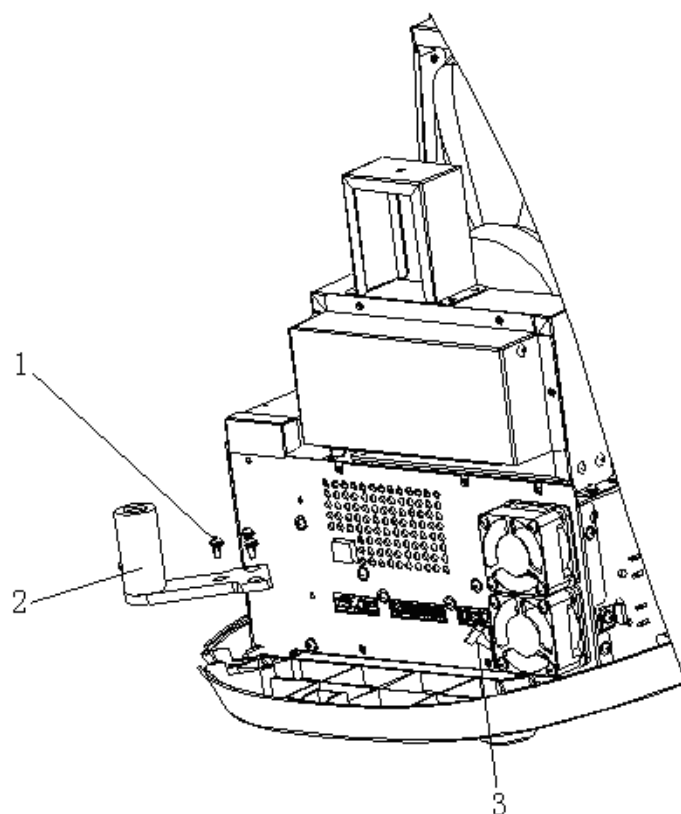


Figure 4-11 Sketch Map of Back Cover of Main Unit Box Disassembly (1)

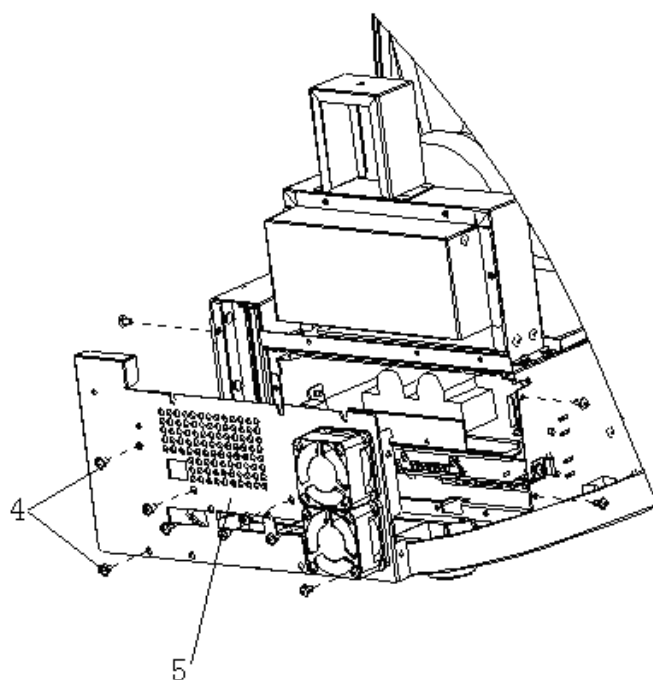


Figure 4-12 Sketch Map of Back Cover of Main Unit Box Disassembly (2)

No.	Name	PN number
1	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
2	Hook seat	2300-20-29085
3	Internal USB external interface wire	2303-20-89059
4	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
5	Back cover module of main unit box	2304-30-89222

- 1) Implementing the procedures from 4.2.1 to 4.2.3, remove rear board module of main unit box.
- 2) Remove three M3X6 screws which are used to secure hook seat, and then pull out USB cable can remove hook seat.
- 3) Remove twelve M3X6 screws which are used to secure back cover, and then remove back cover module.

4.2.5 Disassemble and Replace Power supply board

- 1) Implementing the procedures from 4.2.1 to 4.2.4, remove back board module of main unit box.
- 2) Pull out power supply board module outwards.

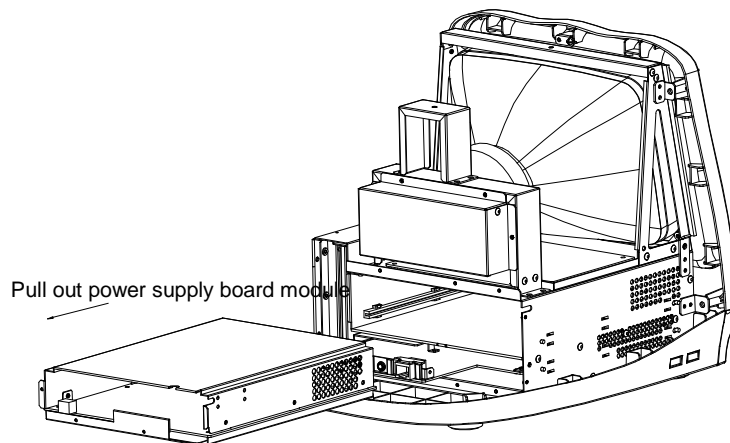


Figure 4-13 Sketch Map of Power supply board Module Disassembly

- 3) Remove six M3X6 screws which are used to secure top cover of power box and open it.

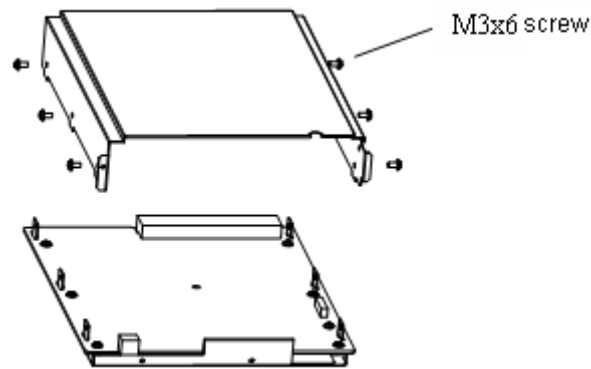


Figure 4-14 Sketch Map of Top Cover Disassembly

- 4) Remove seven M3X8 screws which are used to secure power supply board, and then remove power supply board.

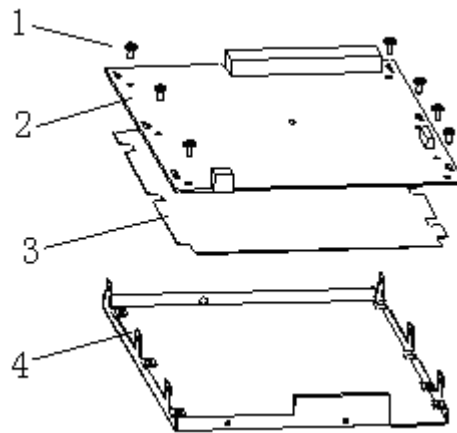


Figure 4-15 Sketch Map of Power supply board Disassembly

No.	Name	PN number
1	Philips small pan head screw combination GB/T9074.8 M3X8 antirust nickel plating	M04-051140---
2	Power supply board	9906-30-71431
3	Shield pad of power box	2300-20-29202
4	Lower cover of power box	2300-20-29195

4.2.6 Disassemble and Replace Main Board and Probe Board

- 1) Implementing the procedures from 4.2.1 to 4.2.4, remove IO back cover module and back cover module.
- 2) Remove three M3X8 screws which are used to secure the seat of probe cable hook, and then remove the seat.

- 3) Remove eight M3X6 screws which are used to secure probe socket and one M3X6 screw which are used to secure main board.

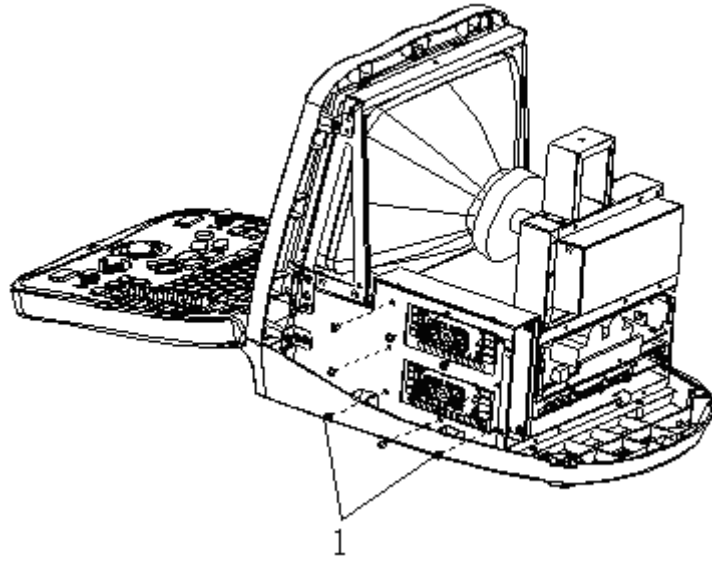


Figure 4-16 Sketch Map of Probe Board and Main Board Disassembly (1)

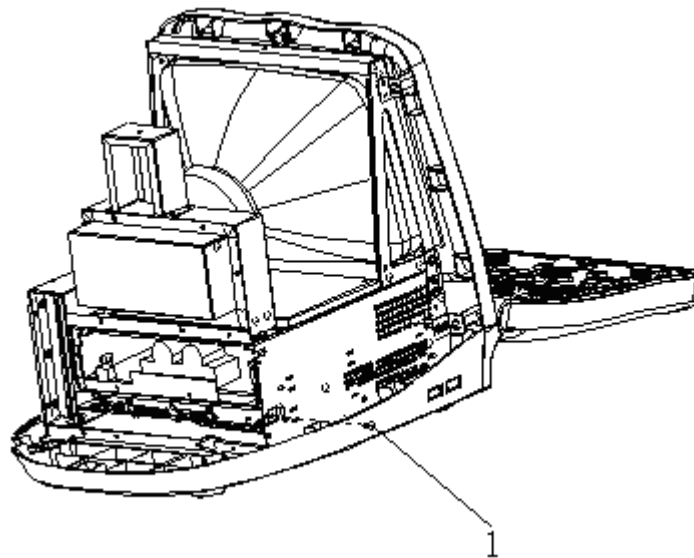


Figure 4-17 Sketch Map of Probe Board and Main Board Disassembly (2)

- 4) Pull out main board and probe board module backwards.

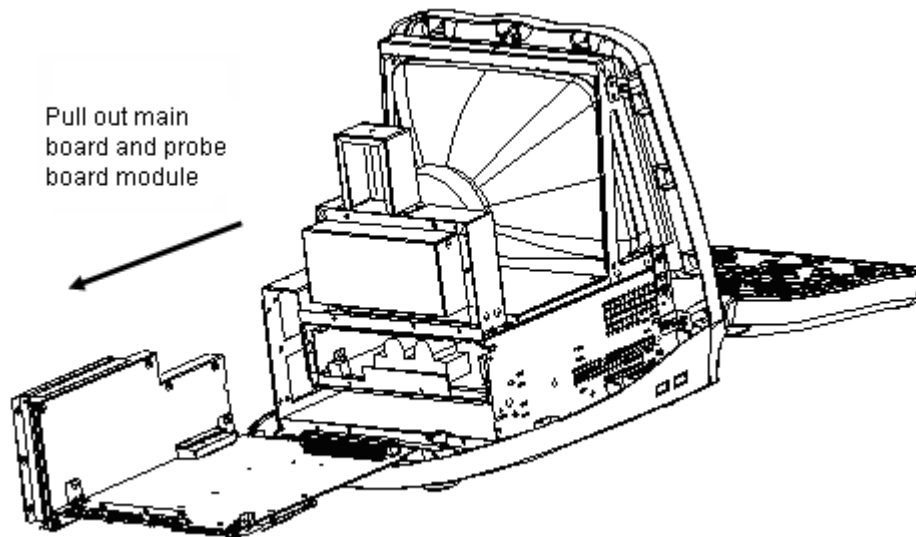


Figure 4-18 Sketch Map of Probe Board and Main Board Disassembly (3)

- 5) Remove two M3X6 connection screws of main board and probe board module, and then remove main board from probe board.

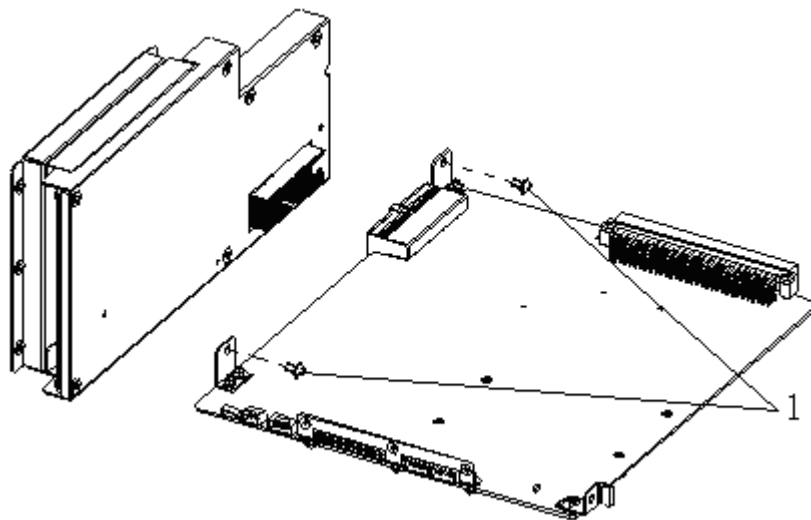


Figure 4-19 Sketch Map of Probe Board and Main Board Disassembly (4)

- 6) Replace main board:
 - a) Remove three M3X6 screws which are used to secure ground sheet-metal and sheet-metal itself.
 - b) Remove respectively two stationary barriers of main board and four M3X6 screws.
 - c) Remove the M3X6 screw which are used to secure stationary holder of main board and the holder itself, and then replace the main board.

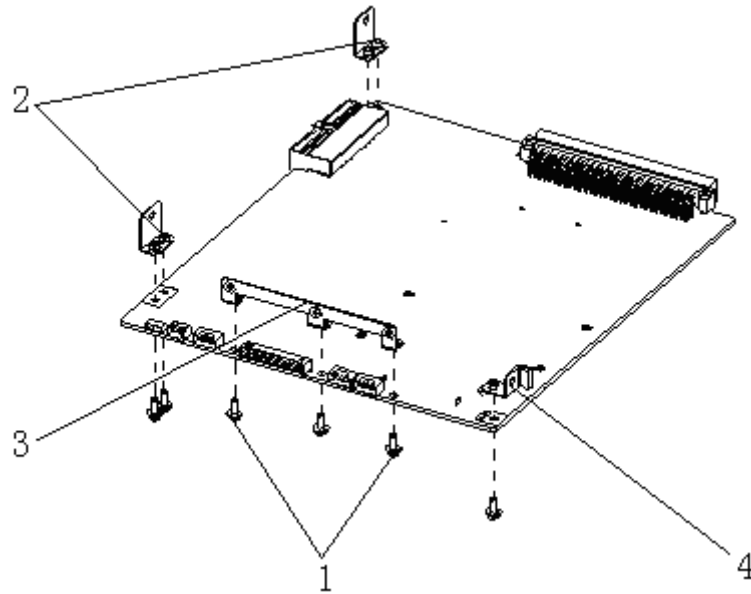


Figure 4-20 Sketch Map of Probe Board and Mian Board Disassembly (5)

7) Replace probe board:

- a) Remove seven M3X6 screws which are used to secure shielding cover of probe board, and remove shielding cover.

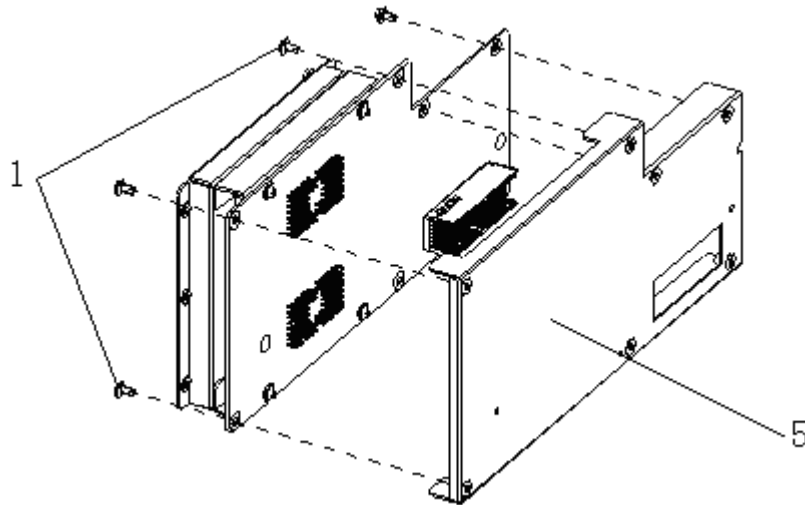


Figure 4-21 Sketch Map of Probe Board and Mian Board Disassembly (6)

- b) Replace probe board after removing four M3X6 screws which are used to secure probe board.

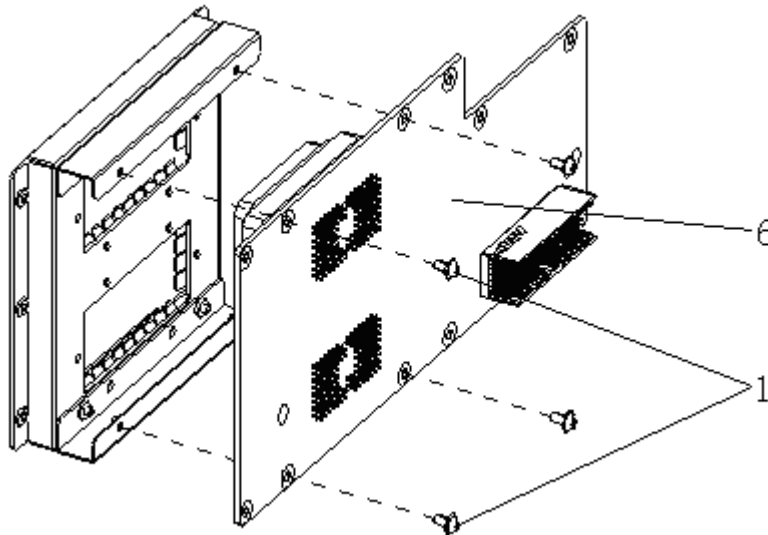


Figure 4-22 Sketch Map of Probe Board and Main Board Disassembly (7)

No.	Name	PN number
1	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
2	Stationary barrier of main board (2)	2304-20-89210
3	Ground sheet-metal	2304-20-89244
4	Stationary holder of main board	2304-20-89211
5	Shielding cover of probe board	2304-20-89213
6	Single socket probe board PCBA	2303-30-89051
	Double sockets probe board PCBA	2304-30-89201

4.2.7 Disassemble and Replace Harddisk (Optional devices)

- 1) Implementing procedures 1 to 6 of 4.2.6, remove main board.
- 2) Remove four M3X6 screws which are used to secure harddisk module, and remove harddisk module.

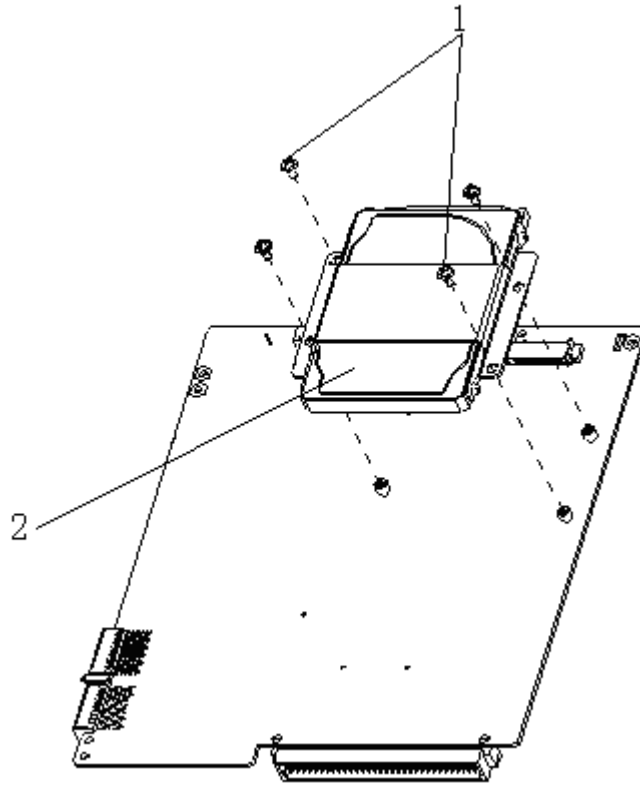


Figure 4-23 Sketch Map of Harddisk Disassembly (1)

- 3) Remove four M3X4 screws to remove stationary barrier of harddisk and replace harddisk.

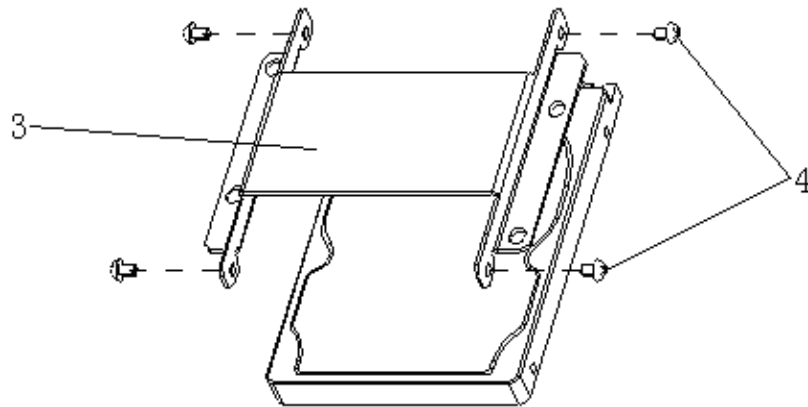


Figure 4-24 Sketch Map of Harddisk Disassembly (2)

No.	Name	PN number
1	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
2	Harddisk 80G 5400rpm 8MBSATA interface laptop	0000-10-10790
3	Stationary barrier of harddisk	2304-20-89212

4.2.8 Disassemble and Replace CRT, CRT Adjustment Board and Main Unit Connection Board

- 1) Implement the procedures in 4.2.1-4.2.3 to remove back cover, and remove IO back cover module and back board module.
- 2) Remove four PT4X14 screws which are used to secure front cover.

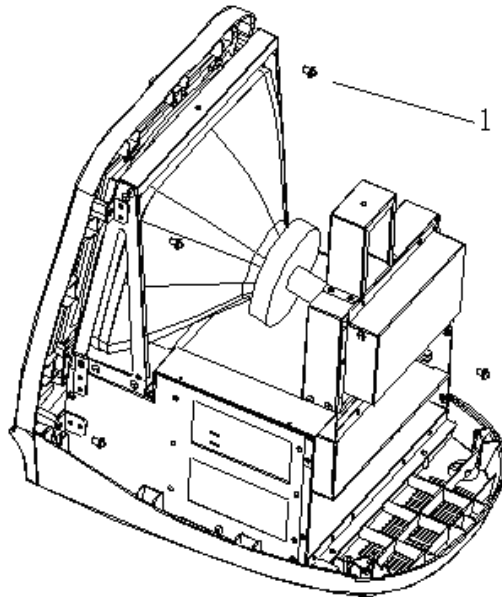


Figure 4-25 Sketch Map of Screws of Front Cover Disassembly

- 3) Remove CRT signal wire, keyboard connection wire, CRT power wire and CRT adjustment tie.

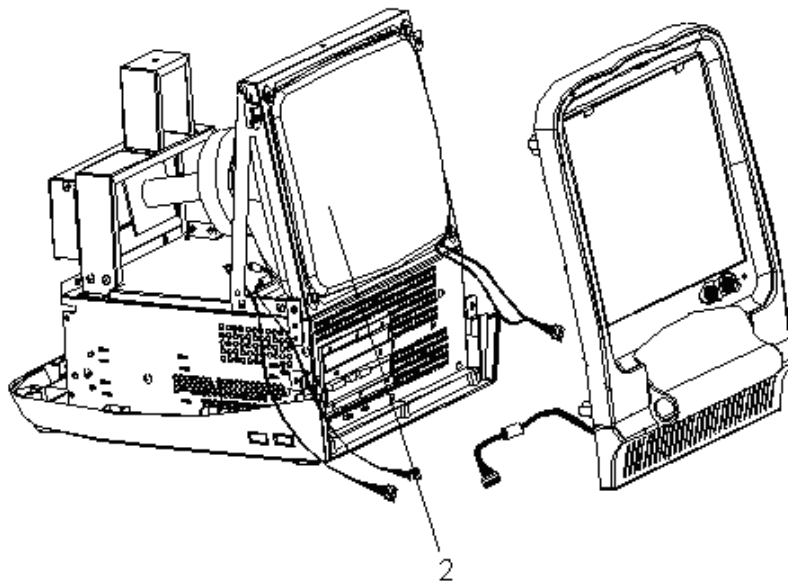


Figure 4-26 Sketch Map of Each Wire Disassembly

- 4) Remove eight M3X8 screws which are used to secure CRT to remove CRT assembly.

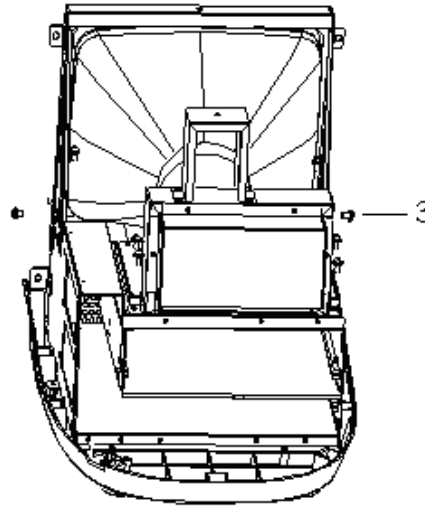


Figure 4-27 Sketch Map of CRT assembly Disassembly

- 5) Remove CRT adjustment knob and four PT3X8 screws which are used to secure CRT adjustment board, and remove CRT adjustment board.

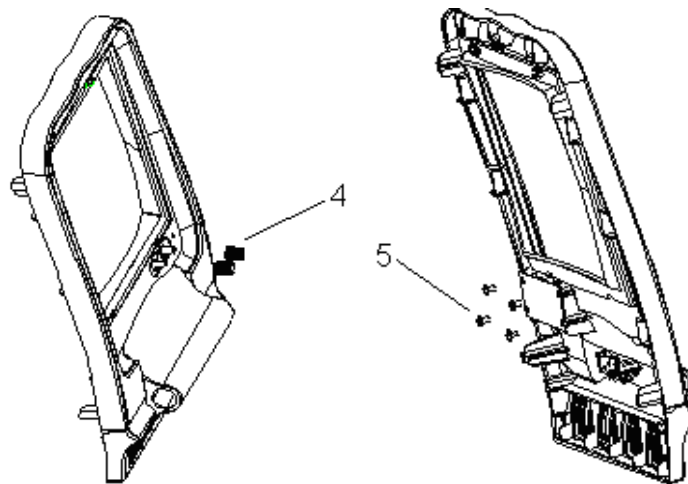


Figure 4-28 Sketch Map of CRT Adjustment Knob Disassembly

- 6) Remove eight M3X6 screws which are used to secure connection board of main unit to remove the connection board.

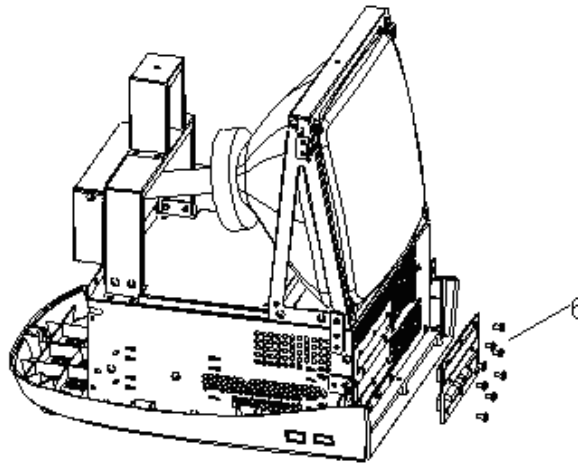


Figure 4-29 Sketch Map of Connection Board of Main Unit Disassembly

No.	Name	PN number
1	Philips pan head tapping screw PT4X14 bright nickel plating	M04-051085---
2	CRT assembly	2300-20-29149
3	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
4	Adjustment knob of monitor (die MR29074)	2300-20-29084
5	Philips pan head tapping screw PT3X8 bright nickel plating	M04-003105---
6	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---

4.2.9 Disassemble and Replace Monitor Protection Screen

- 1) Slide respectively two fixing buckles which are used to secure monitor protection screen and pull the buckles out.
- 2) Pull out the top of monitor protection screen outwards and lift it up to remove it.

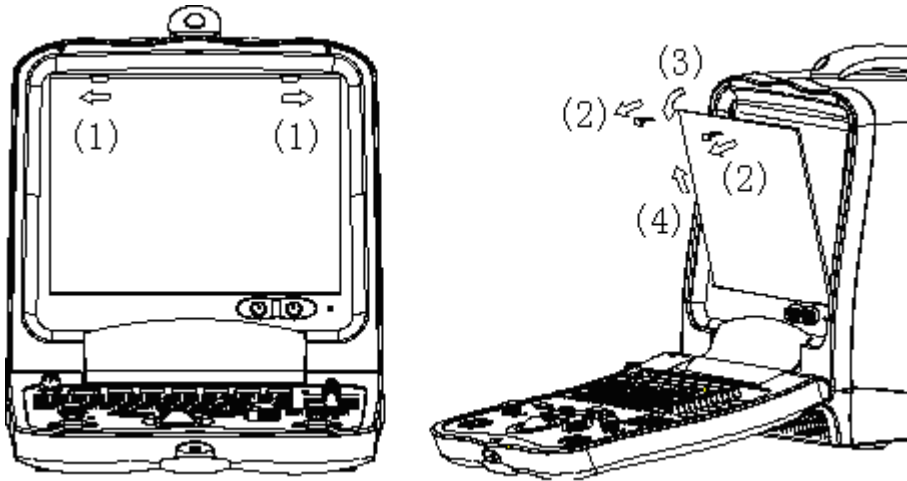


Figure 4-30 Sketch Map of Monitor Protection Screen Disassembly

4.2.10 Disassemble Keyboard, Trackball and Speaker

- 1) Remove two silica gel caps of keyboard and two M3X6 screws which are used to secure top cover of keyboard.

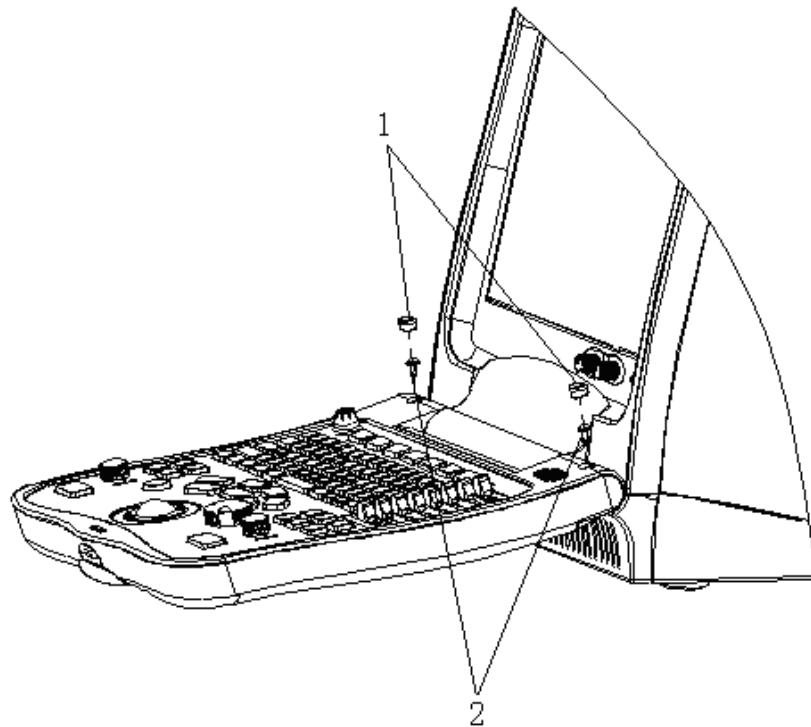


Figure 4-31 Sketch Map of Silica Gel Caps of Screen Disassembly

- 2) Remove upwards the top cover of keyboard by putting hands on the position shown in the figure below.

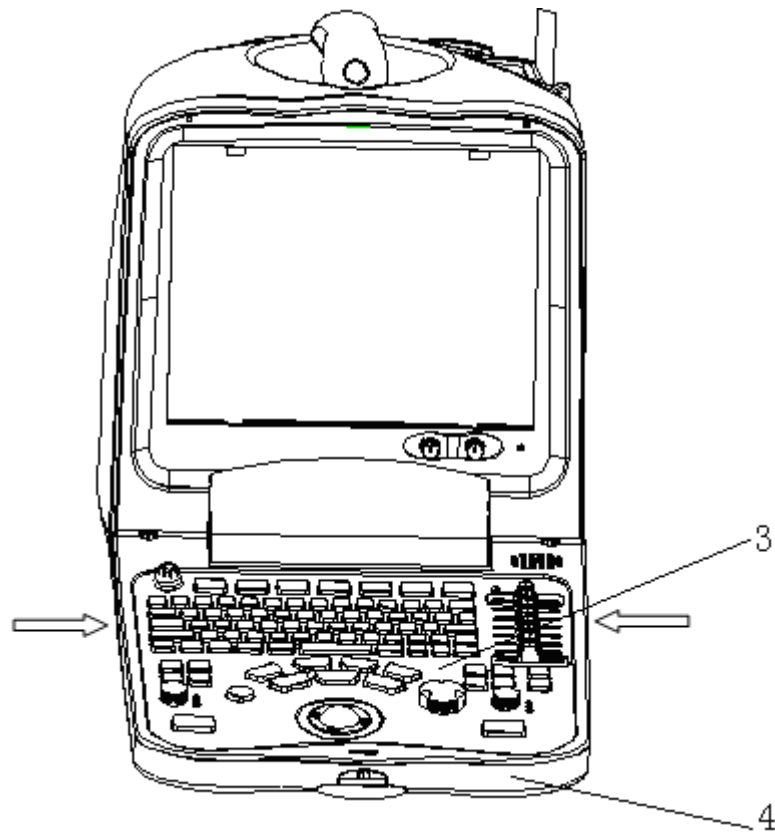


Figure 4-32 Sketch Map of Top Cover of Keyboard Disassembly

- 3) Pull out the tie of keyboard connection wire and remove top cover of keyboard.

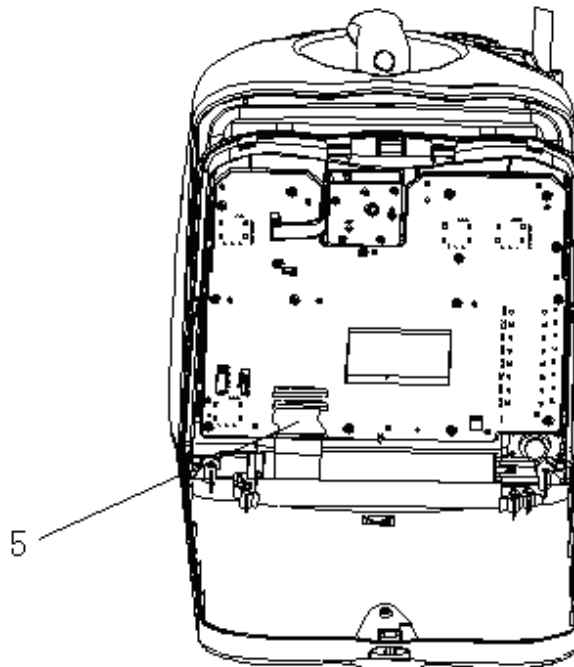


Figure 4-33 Sketch Map of Top Cover of Keyboard Disassembly

- 4) Pull out the tie near to trackball connection wire, and remove four ST3x14 tapping screws which are used to secure trackball, and then remove trackball.

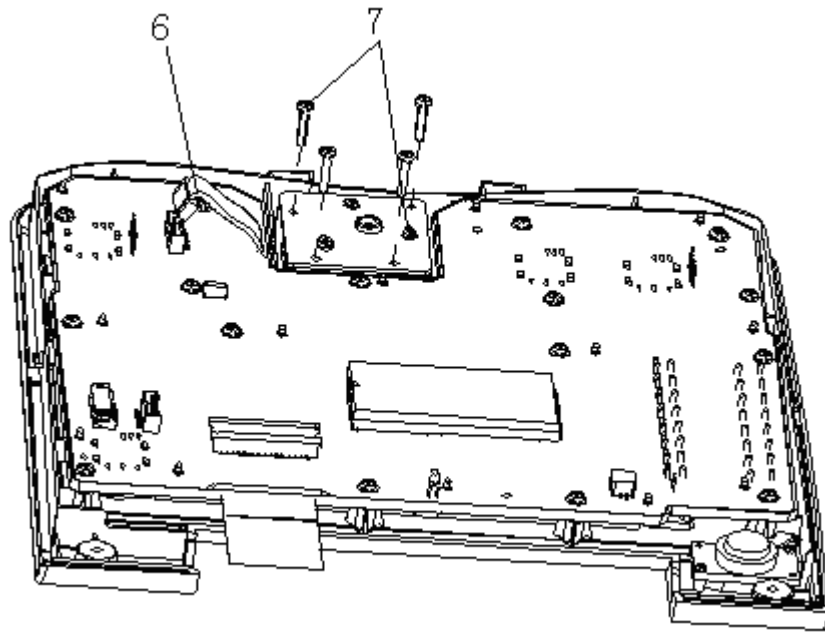


Figure 4-34 Sketch Map of Trackball Disassembly

- 5) Pull out keyboard knob A, two keyboard knobs B, keyboard knob C and eight keyboard knobs.

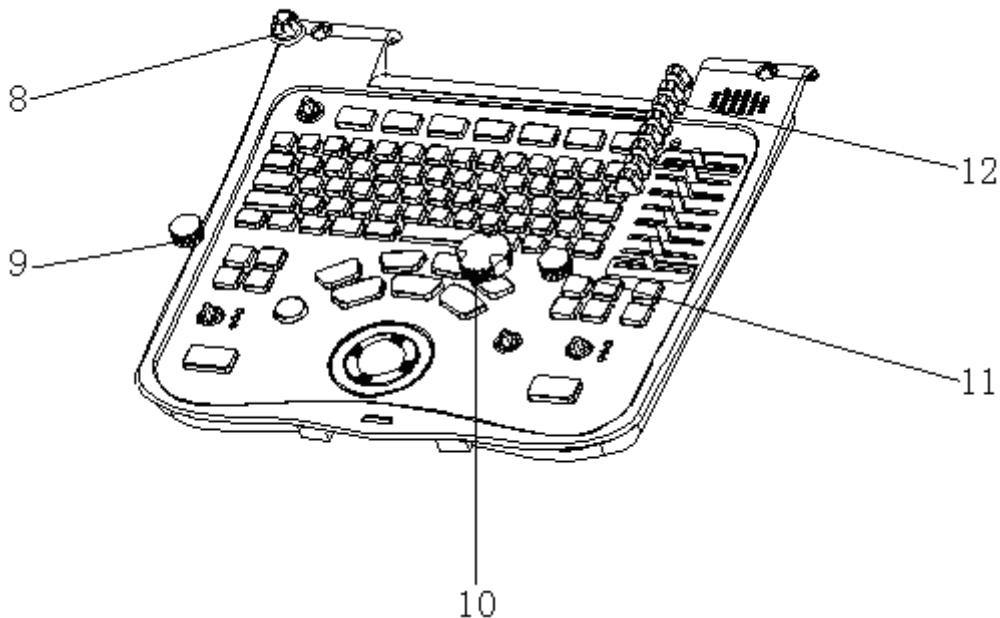


Figure 4-35 Sketch Map of Keyboard Knobs Disassembly

- 6) Pull out the tie of speaker connection wire, and remove fourteen ST3x8 screws which are used to secure keyboard, and then remove silicon rubberkey to remove keyboard PCB. Remove two ST2x6 screws which are used to secure speaker to remove the speaker.

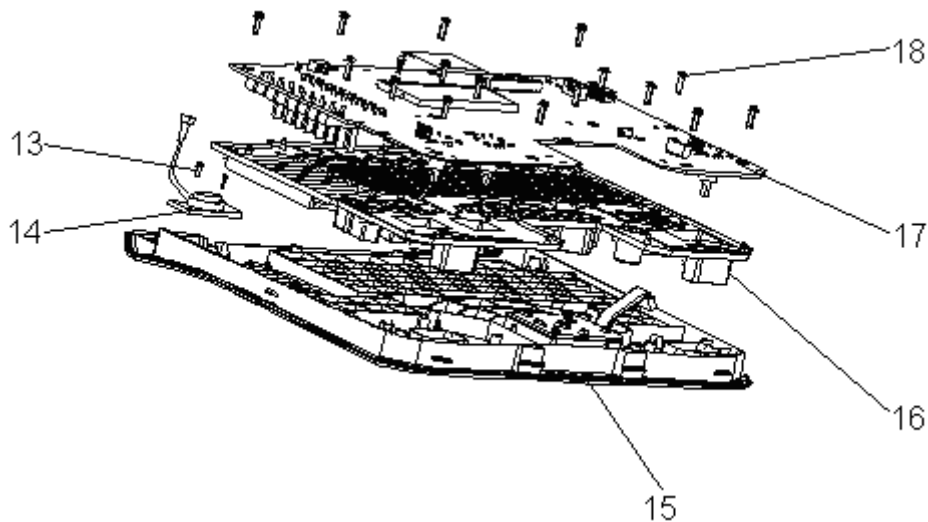


Figure 4-36 Sketch Map of Speaker Disassembly

No.	Name	PN number
1	Keyboard silicon rubbercap (die MR29076)	2300-20-29076
2	Philips small pan head screw with pad GB9074.5-88 M3X6 antirust nickel plating	M04-004012---
3	Lower cover module of keyboard	2303-30-89064
	Lower cover module of keyboard	2304-30-89220
4	Top cover module of keyboard	2303-30-89065
	Top cover module of keyboard	2304-30-89221
5	Keyboard signal wire	2303-20-89055
6	Connection wire of trackball (CS02)	009-000256-00
7	Philips pan head tapping screw PT3X14 bright nickel plating	M04-051122---
8	Keyboard knob C(die MR29071)	2300-20-29073
9	Keyboard knob B(die MR29071)	2300-20-29072
10	Keyboard knob A(die MR29071)	2300-20-29071
11	Keyboard knob B(die MR29071)	2300-20-29072
12	Sliding bar (die MR29074)	2300-20-29074
13	Philips pan head tapping screw PT2.0X6 bright nickel plating	M04-051003---
14	SPEAKER 8 ohm 15% 1.0W SPL 86	M90-100123---
15	DP-6900 top cover of keyboard	2304-20-89237-51
16	DP-4900 silicon rubberkey	049-000041-00

	DP-6900 silicon rubberkey	049-000040-00
17	Control panel PCBA	051-000183-00
18	Philips pan head tapping screw PT3X8 bright nickel plating	M04-003105---

4.2.11 Disassemble and Replace Fan and Dustproof Net

- 1) Implementing the procedure in 4.2.1, remove back cover.
- 2) Remove the tie of fan on rear board and four M3X30 screws to remove the fan.

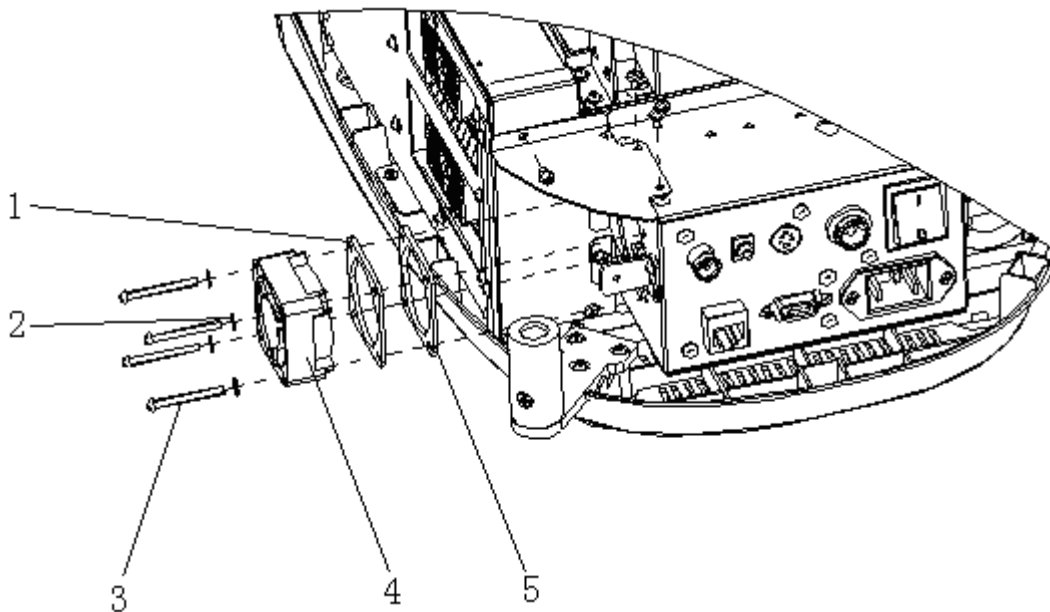


Figure 4-37 Sketch Map of Fan on Rear Board Disassembly

- 3) Remove the tie of fan on back board and eight M3X30 screws to remove the fan.

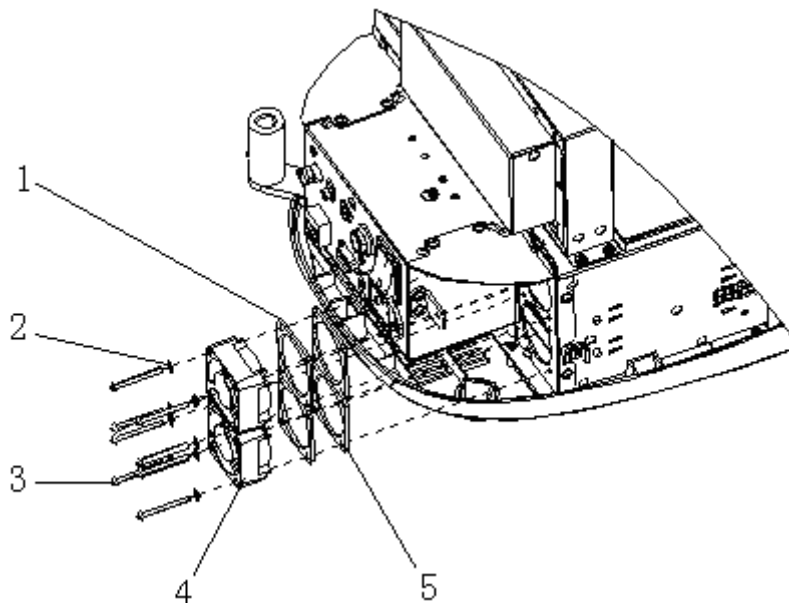


Figure 4-38 Sketch Map of Fan on Back Board Disassembly

No.	Name	PN number
1	Small fan pad	2300-20-29099
2	Plain washer-class A GB/T97.1-20023 antirust nickel plating	M04-000802---
3	Philips pan head screw GB/T818-2000 M3X30 antirust nickel plating	M04-002705---
4	FAN 12V 6.3cfm 18dB40*40*20MM CS02 main unit module	M90-000185---
5	Steel mesh	2300-20-29256

4.2.12 Disassemble USB Extension Line

- 1) Implementing the procedures from 4.2.1 to 4.2.3 and the procedures in 4.2.8, remove back cover, IO back cover, back cover module of main unit and front cover module.
- 2) Remove seven PT3x8 crews which are used to secure enclosure bottom and remove main unit box.

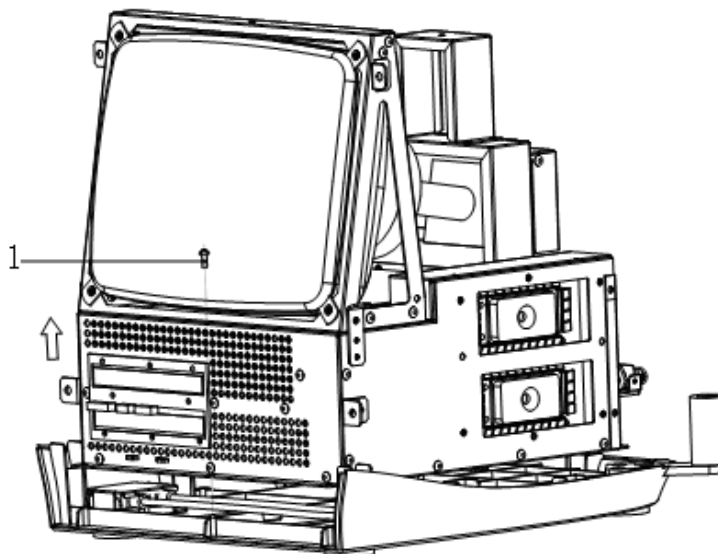


Figure 4-39 Sketch Map of Main Unit Box Disassembly

- 3) Remove two PT3x8 screws which are used to secure USB press plate, and remove it to take out USB extension line.

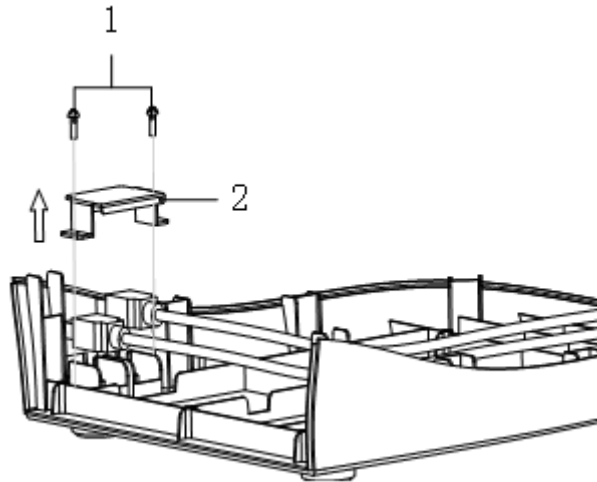


Figure 4-40 Sketch Map of USB Extension Line Disassembly

No.	Name	PN number
1	Philips pan head tapping screw PT3X8 bright nickel plating	M04-003105---
2	USB press plate	2300-20-29106

4.3 Installation of Optional Devices

4.3.1 Installation of Video Printer

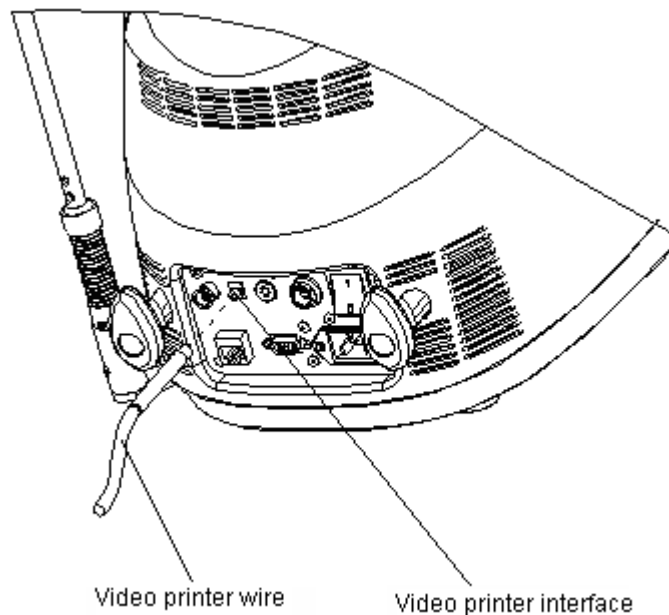


Figure 4-41 Sketch Map of Video Printer Connection

4.3.2 AC Mobile Power DA-88

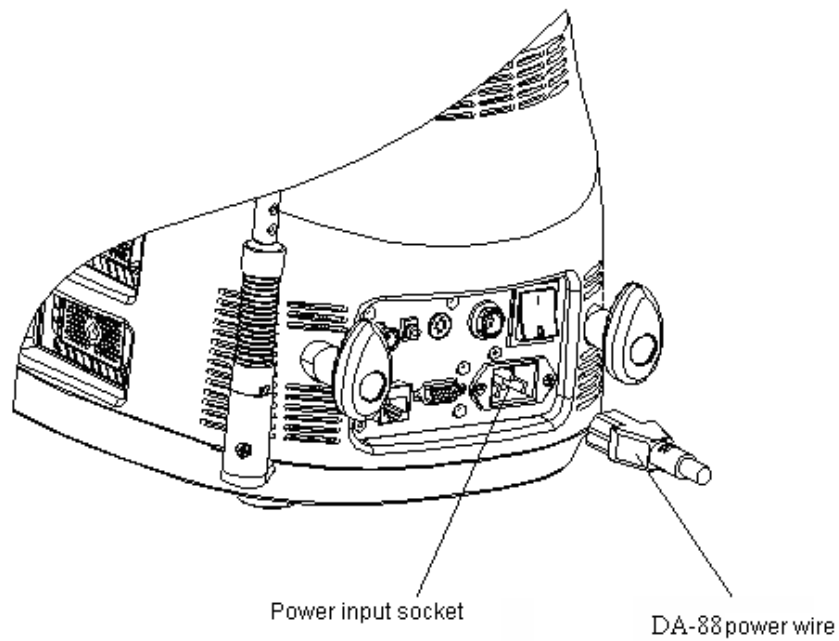


Figure 4-42 Sketch Map of Mobile Power Connection

4.3.3 Footswitch

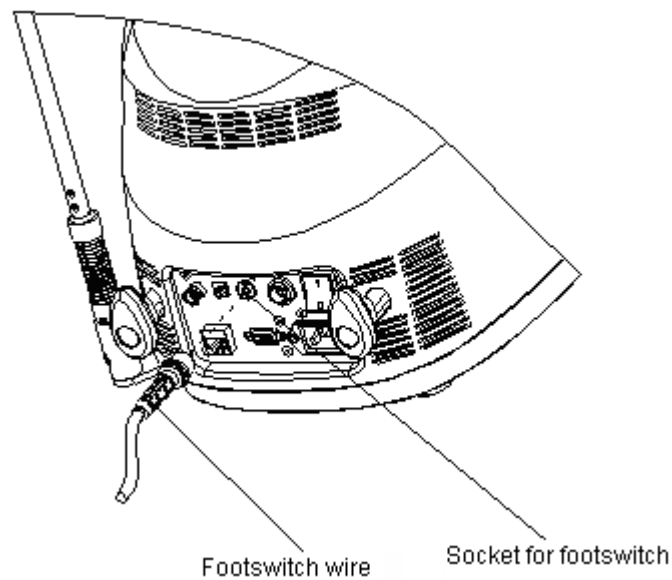


Figure 4-43 Sketch Map of Footswitch Connection

5

Maintenance Requirements

5.1 Tools Used in Maintenance

5.1.1 Tools, Measurement Devices, Consumables

Tools and Measurement Devices

Tool/Device	Qty.	Description
Resin or stainless steel container	1	Can hold two probes
Plastic bag	1	About 2m×2m (0.3mm thickness)
Vacuum dust-collector	1	
Air blower (600W ~16000 mm/min)	1	Makita 4014NV or like devices
Cleaner		
Brush	1	About a toothbrush size

Consumables

Consumable	Qty.	Description
Aluminum foil	1	
Physiological saline		To fill the whole container (0.85 - 0.95%)
Glass cleaner	1	To clean the display
Neutral cleanser		
Soft cloth		

- NOTE:**
- 1 Do not use soluble solvent (such as paint thinner or gasoline) or abrasive cleanser to clean the system. Otherwise, the system may be damaged.
 - 2 Do not use hydrocarbon detergent or detergent used on OA equipments to clean the screen. Otherwise, the display performance may degrade.

Tools

Tool	Model	Manufacturer	Specification/Standard
Screwdrivers (all models and sizes)			Not specified
Blunt cross screwdriver (big)			Not specified
Wire cutting pliers			Not specified
Sharp nose pliers			Not specified
Diagonal cutting pliers			Not specified
Electric iron and its holder			Not specified
De-soldering gun			Not specified
Wrench suite			Not specified
Adjustable wrench			Not specified
Tweezers			Not specified
Hammer			Not specified
Metric general wrench suite			Not specified
Cable (all models)			Not specified
Knife			Not specified

Consumables

Consumable	Model	Manufacturer	Specification/Standard
Insulating tape			Not specified
Hishilite tube (heat shrink tube), insulating tube (all models)			Not specified
Cable (all models)			Not specified
Screws, nuts, gaskets (all models)			Not specified
Solder stick			
File folders (all models)			
Alcohol for cleaning and disinfection			

5.2 Maintenance Personnel

To ensure the system performance and safety, only Mindray engineers or engineers authorized by Mindray can perform maintenance.

6

Checking

6.1 System Status Checking

6.1.1 Checking Plan

Check plan within one year after installation:

Model	Check times		Remarks
	6 months after installation	12 months after installation	
DP-4900/6900/SK-40	—	1	

6.1.2 Confirmation before Checking

6.1.2.1 Checking System Status

Check the following items or the log together with the customer to confirm the system status.

- 1) Any abnormality when the system is running;
- 2) Occasional abnormality;
- 3) Other items the customer requires to check.

6.1.2.2 Checking Operation Environment

Check the ambient temperature and humidity. The measurements related to safety features are sensitive to humidity, and measurement position and circuit as well.

If the insulation feature of the system degrades as the service time increases or due to the system malfunctions, the deflection range of measurement result may increase as the humidity increases.

6.1.2.3 Checking System Setup

Check the system's preset, contrast and brightness of display, optional parts, probes, etc.

6.1.2.4 Checking the System Version

Press [Setup] key on the control panel to enter the menu of Setup, select [About] to enter the system information page for system version checking.

6.1.2.5 Checking System Running Status

Check if all menus and dialog boxes can pop up normally.

Check if measurements can be performed in each exam mode.

Check if exam modes can be switched normally.

Check if images modes can be switched normally.

Check if probes can be switched normally.

6.2 Checking Functionality

6.2.1 Flow of Functionality Checking

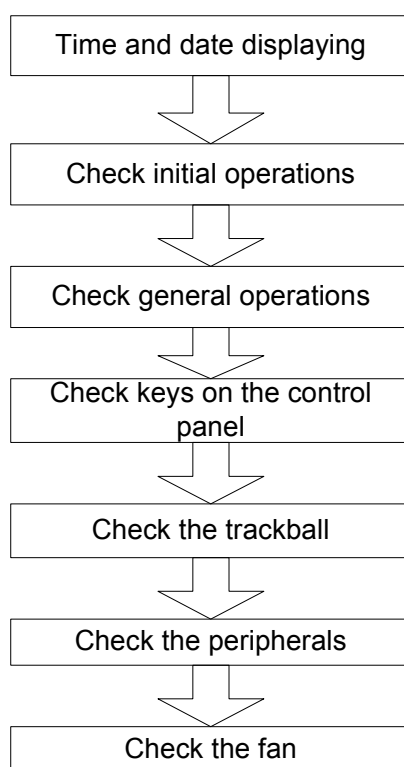


Figure 6-1 Functionality Checking

6.2.2 Details of Functionality Check

- 1) Time and date displaying
 - Confirm the time and date displayed is correct.
 - If they are incorrect, correct them.
- 2) Checking the initial operations
 - Check the functions of keys under each mode.

- Check the images produced by each probe and print them.
 - Check the functions of peripherals.
- 3) Checking general operations
- Check if the [Freeze] key can work normally.
 - Check if the total gain can be adjusted properly.
- 4) Checking keys on the control panel
- Check all keys on the control panel from left to right and from up to down to see if they can work properly.
 - If a video printer is connected to the system, check if the [Print] key can work normally.
- 5) Checking the trackball
- Press the [Freeze] key to enter the image freeze status. Press the [Measure] key to enter the measurement status.
 - Measure the vertical distance and horizontal distance to see if the trackball can work normally.
- 6) Checking the peripherals
- Check if the probes can be pulled out properly. Check if the probes can work normally after been connected to the main unit.
- 7) Checking the fans
- Check if the system fan (fan in the main unit) can work normally after the main unit is powered on.
 - Check if the fans make any abnormal noise when they are working.

6.3 Safety Checking

6.3.1 Mechanical Safety Checking

6.3.1.1 Evaluation

Perform the evaluation by eye-measuring and checks.

6.3.1.2 Checking Flow

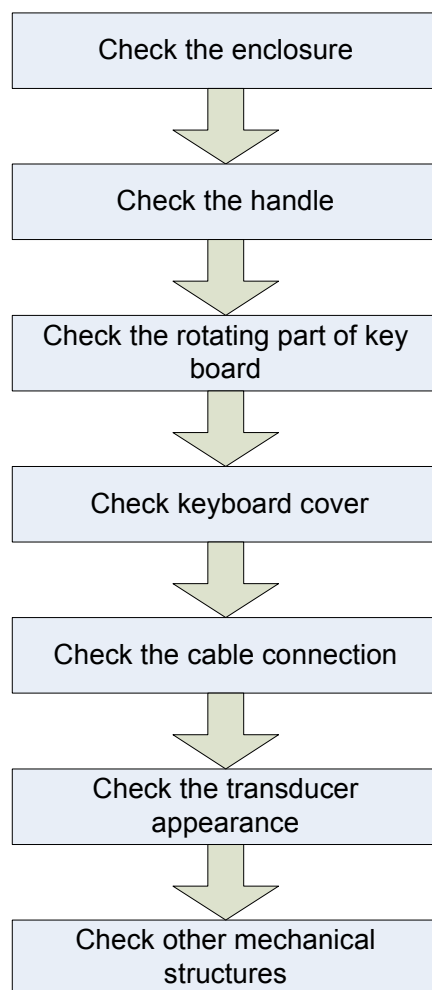


Figure 6-2 Cchecking Flow of Mechanical Safety

If the check result is “fail”, the system is in abnormal status. Stop the system and adopt proper measures.

Type	Check	Procedure	Tool
Mechanical safety	Enclosure	Check by sight if the enclosure has any crack.	
	Handle	1) Check by sight if the handle has any crack.	
		2) Pull the handle to make sure it is not loose.	
	Check the rotating part of keyboard	Pull the keyboard to make sure it is not loose.	
	Keyboard cover	Manually close the keyboard cover and confirm its fastness. The keyboard can only be opened after pressing the control panel buckle.	

	Cable connection	1) Check by sight to make sure that there is no damage happened to the cable both inside and outside the instrument.	Phillips screwdriver
		2) Check manually to make sure that there is no looseness and falling off happened to the cable inside the instrument	
	Probe appearance	Check by sight to make sure that there is no crack, peel, loose and damage happened to the probe	
	Other mechanical structures	Check to make sure that there is no part is crack, and no conducting part is exposing to the outside	

6.3.2 Electrical Safety Checking

Please refer to [Appendix A Electrical Safety Inspection](#).

6.4 Image Checking

Description: You can use the following phantoms, e.g. KS107BD, tissue mimicking ultrasound phantom, which is used for phatom data check. But the phatom is provided by the customer.

6.4.1 Image Recording and Archiving

Print the images and archive them with data recorded.

6.4.2 Checking Flow

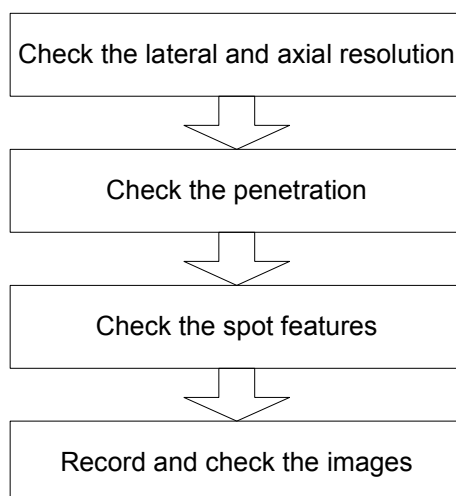


Figure 6-3 Image Checking Flow

6.4.3 Checking Phantom Data

6.4.3.1 Lateral / Axial Resolution

- 1) Put some gel on the phantom and then scan the phantom with a probe.
- 2) After obtaining an optimal image, freeze the image and record it.

Condition: system preset parameters.

6.4.3.2 Penetration

- 1) Put some gel on the phantom and then scan the phantom with a probe.
- 2) Adjust the gain to make the soft tissue spot displayed at the deepest position.
- 3) Measure the depths of noise and of the soft tissue boundary, and record the images for the measurement.

6.4.3.3 Spot Features

Evaluate the change of image quality after the system is used for a long time. The evaluation items include the gain, and the periodic record of the images described above.

6.4.3.4 Recording images

Archive the images printed out according to the descriptions above.

6.4.4 Final Operation Checking and Image Archiving

6.4.4.1 Operation Checking

Check image operations with each probe in each mode.

6.4.4.2 Image Printing and Archiving

Print images and archive them with data recorded.

6.4.4.3 Checking Flow

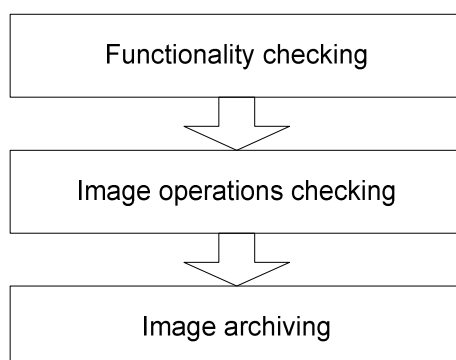


Figure 6-4 Final Operation Checking Flow

6.4.4.4 Checking Details

- 1) Functionality check

Check changes of the exam mode, measurements and related information.

2) Image operation check

Perform image operations with each probe in each mode.

3) Image archiving

Print images obtained through the steps above and archive them.

7

System Maintenance

7.1 System Cleaning

NOTE:	Before cleaning the system, you must switch off the system and pull out power cord. If you clean the system when it's on, it may cause electric shock.
--------------	--------------------------------------------------------------------------------------------------------------------------------------------------------

7.1.1 Cleaning Flow

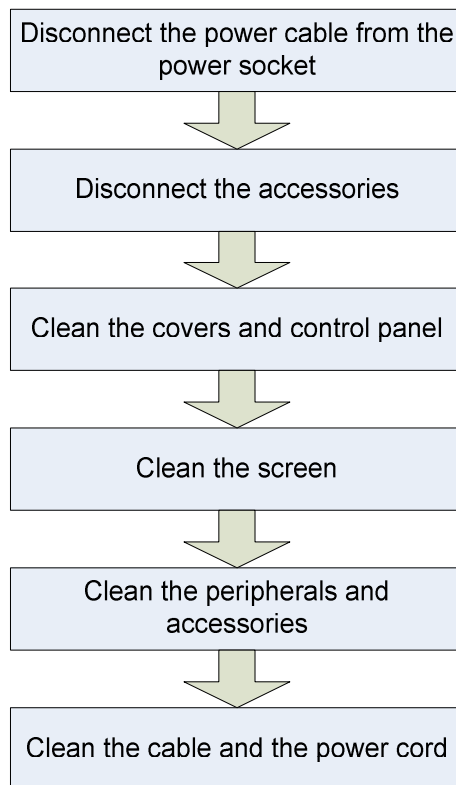


Figure 7-1 Cleaning Flow

7.1.2 Details for Cleaning

- 1) Clean the interior of main unit and fans

Disconnect the power cord from the power socket.

Disassemble accessories such as probes and printers.

2) Clean the enclosure and control panel

Use neutral cleanser to remove the dust on the enclosure of main unit and on the control panel. If it is difficult to clean the control panel, disassemble the keys first and then use neutral cleanser to clean it.

3) Clean the screen

Make sure the screen is not skew and the fixing mechanism is secured.

Using a soft cloth, apply a glass cleaner directly to the cloth and wipe down the screen to remove finger marks, dust and smudges. Allow the monitor to air-dry.

4) Probe

Please refer to the corresponding probe manual to clean, disinfect and sterilize the probe.

5) Cable / cord

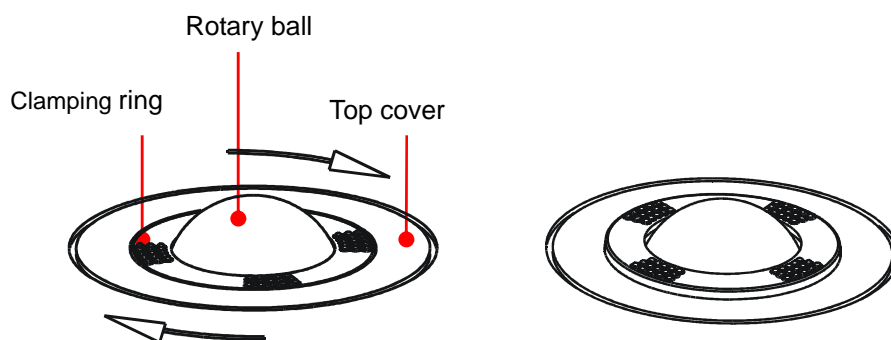
Use neutral cleanser to clean the cable and power cord.

6) Cleaning of the trackball

a) Disassemble

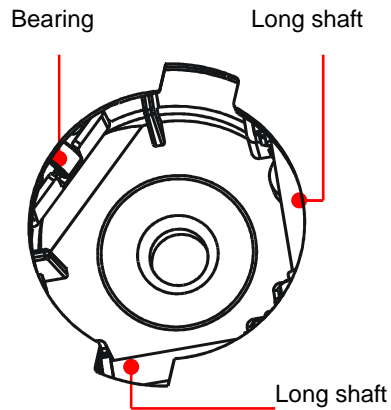
Press the bulges on the clamping ring by both the hands and turn the ring about 45° clockwise until it lifts. Take out the ring and the rotary ball. Be careful not to drop the ball.

Shown as follows:



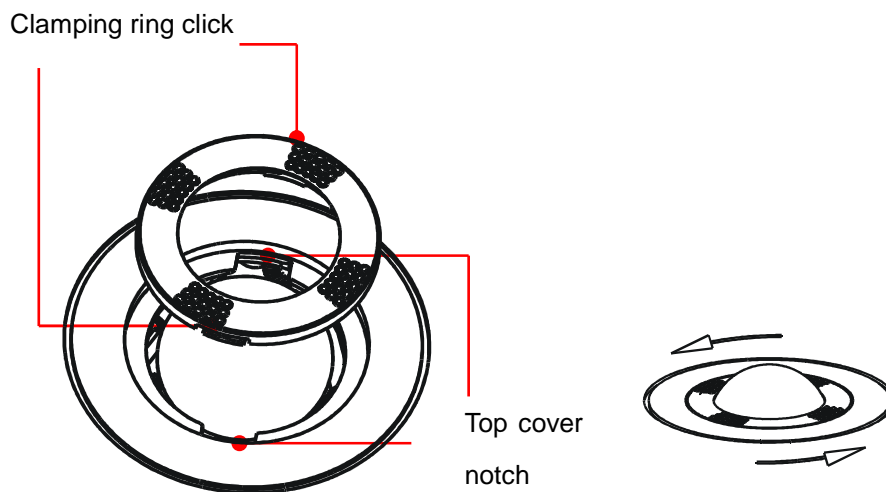
b) Cleaning

Clean the two long shafts, the bearing and the rotary ball with soft dry cloth or paper.



c) Installation

Put the rotary ball back in the trackball and then align the clamping ring click with the top cover notch. Press the bulges on the ring with both hands and turn the ring about 45° counterclockwise until the ring clicks. As the bulges are flush with the top cover, the ring is secured.



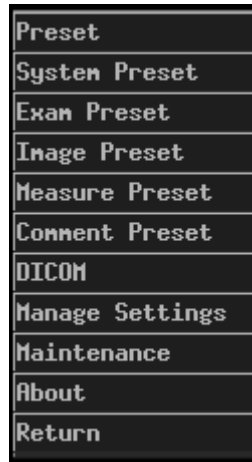
- Note:**
- 1 Don't spill water or other liquid into the system while you perform the cleaning. Otherwise, it may cause malfunction or electric shock.
 - 2 Please contact Mindray Customer Service Department when you need to clean the connector, other connectors of TGC control and peripherals. It may cause malfunction or reduce the performance if you clean it by yourself.

7.2 Software Maintenance

Before performing the software maintenance, ensure the data used matches the model.

7.2.1 Preset

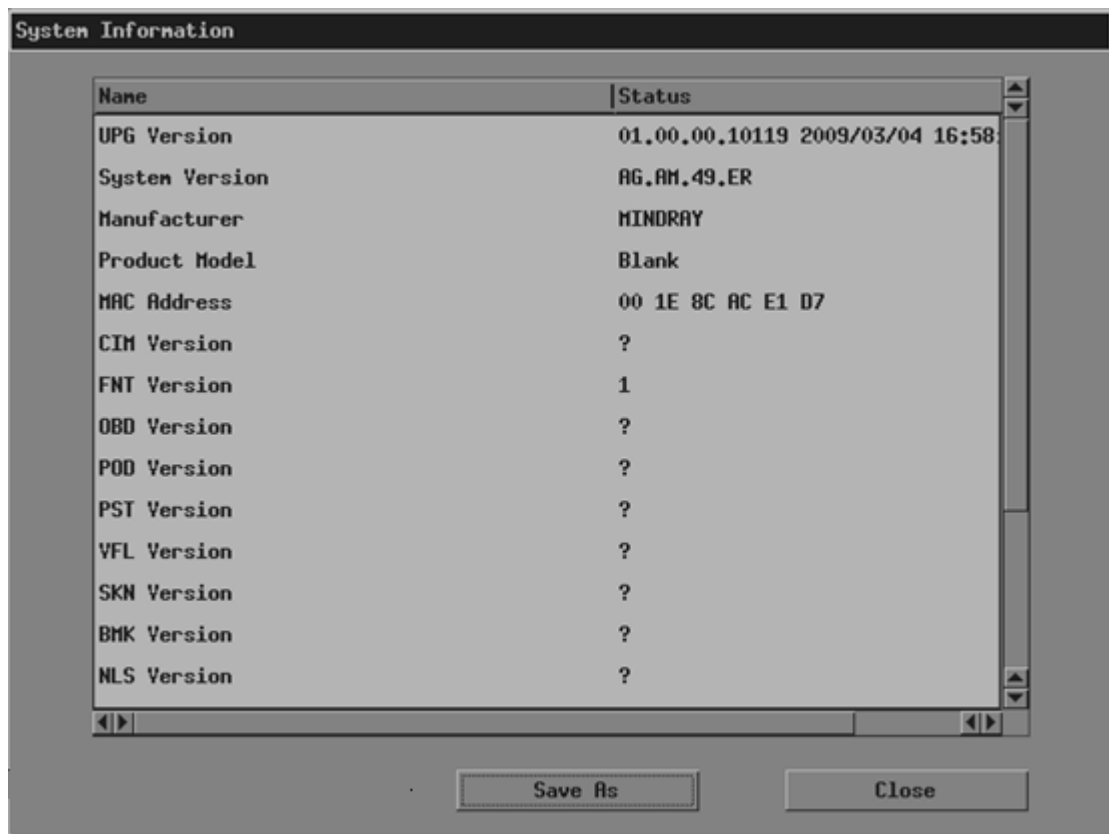
Press [Setup] key to pop up the [Preset] menu.



Preset
System Preset
Exam Preset
Image Preset
Measure Preset
Comment Preset
DICOM
Manage Settings
Maintenance
About
Return

7.2.2 Viewing System Information

In the [Preset] menu, select [System Preset] to show the [System Information] dialog box.



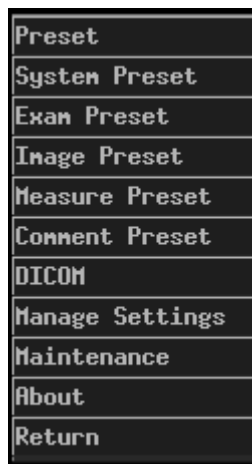
System Information	
Name	Status
UPG Version	01.00.00.10119 2009/03/04 16:58
System Version	AG.AM.49.ER
Manufacturer	MINDRAY
Product Model	Blank
MAC Address	00 1E 8C AC E1 D7
CIM Version	?
FNT Version	1
OBD Version	?
POD Version	?
PST Version	?
VFL Version	?
SKN Version	?
BHK Version	?
NLS Version	?
Save As Close	

NOTE

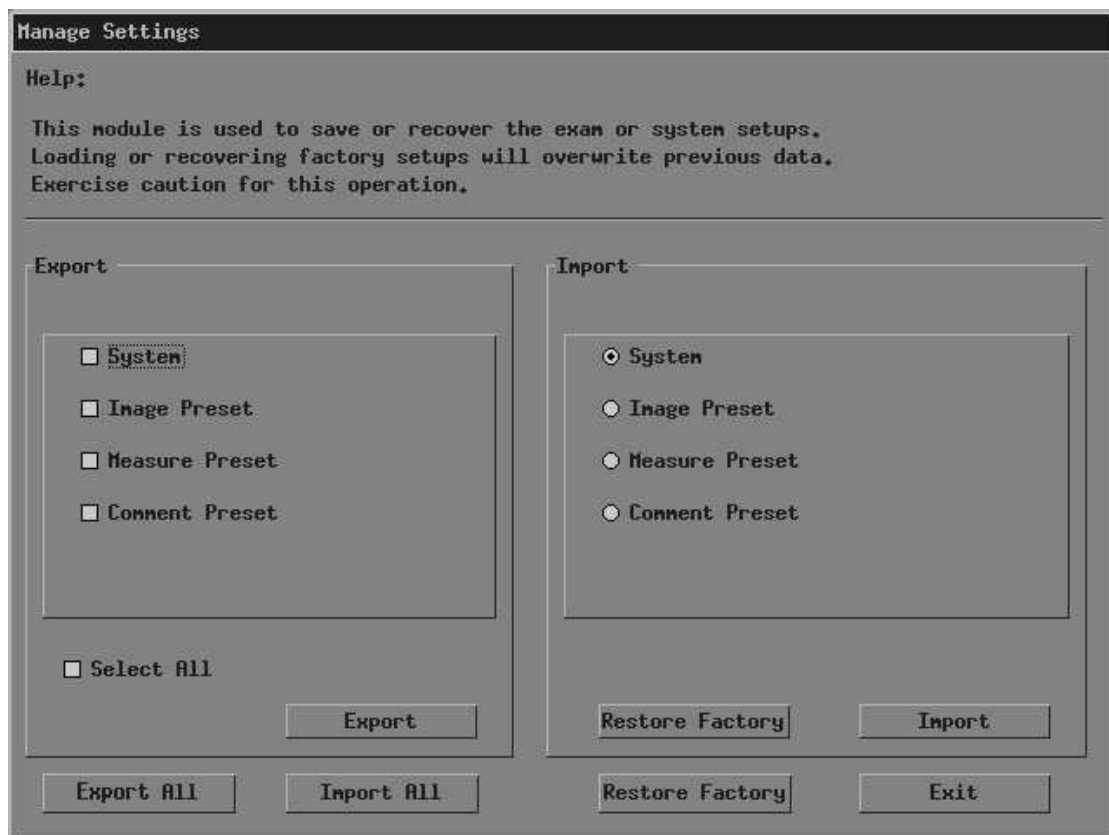
Be sure to confirm the system information before and after the software maintenance.

7.2.3 Data Backup and Recovery

- 1) Press [Setup] key to enter into the preset status.
- 2) Move the cursor onto [Manage Settings] and press [Set].



- 3) Select Export (Import or Restore factory) as required.



Mark

Function

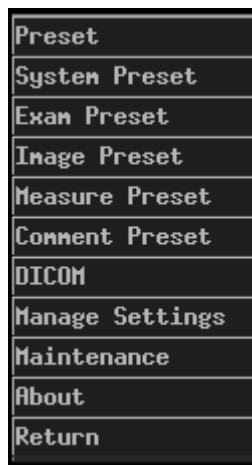
A	To export the selected presets, and save them in different files.
B	To import the preset parameters according to the selection, or to restore it to the original factory default.
C	To export all the preset parameters, and save them in a file.
D	To import all the preset parameters at one time.
E	To restore all preset parameters to the default value.

NOTE: 1 Preset factory setups: c:\cs02\preset\factory
2 Preset data: d:\preset\current

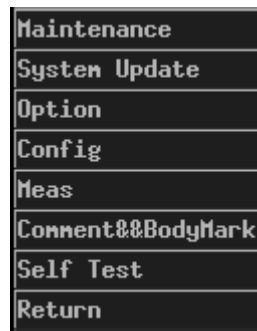
7.2.4 Maintenance Status

Copy the files to be used into a USB flash drive. Then insert the USB flash drive into the USB port on the main unit.

1. Enter into preset status; (Please refer to 7.2.1 Preset)
2. Select [Maintenance].



3. Press [Set] to pop up the following dialog box. Enter the correct password, select [OK], and press [Set] to enter to [Maintenance] menu.



7.2.5 Software Updating

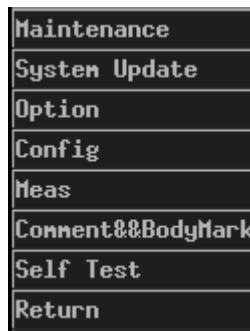
NOTE: Do not turn off the power supply in the process of updating. Otherwise, it will damage the system.

7.2.5.1 Updating

This updating is done through an updating pack, the content to be updated is the content changed in the last version prior to the updating pack.

NOTE: After updating by updating pack, it needs to reupgrade the presetting data single in item. Otherwise it may cause wrong presetting data.

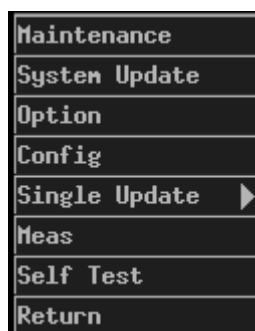
1. Copy updating files into U flash drive, and connect it to the system to be updated.
2. Enter the maintenance status (refer to 7.2.4 Maintenance Status).
3. Select [Update] and press [Set].



4. Select the content of updating pack storage in U flash drive in the dialog box and select the script file (*.TXT) of updating pack, and then click [OK], the system will start updating.
5. After starting updating, there is no need of other operations; the system can automatically implement the updating process for specified updating item in script until its end. When it prompts "System updating finished, please restart the system", click [OK] to confirm the updating.
6. Exit maintenance status, return and restart the system to let the updating take effect.

7.2.5.2 Single Update

1. Copy updating files into U flash drive, and connect it to the system to be upgraded.
2. Enter the maintenance status (refer to 7.2.4 Maintenance Status).
3. Press back+digital 7 to enter the single update.



4. Select the item to be updated, press [Set] to enter [Load file] dialog box, select the updating file in U flash drive according to the selected file type and click [OK] to start updating. The progress will be displayed. After the updating is completed, "Single update finished, please restart the system" will be prompted.
5. Exit maintenance menu, return and restart the system to let the updating take effect.

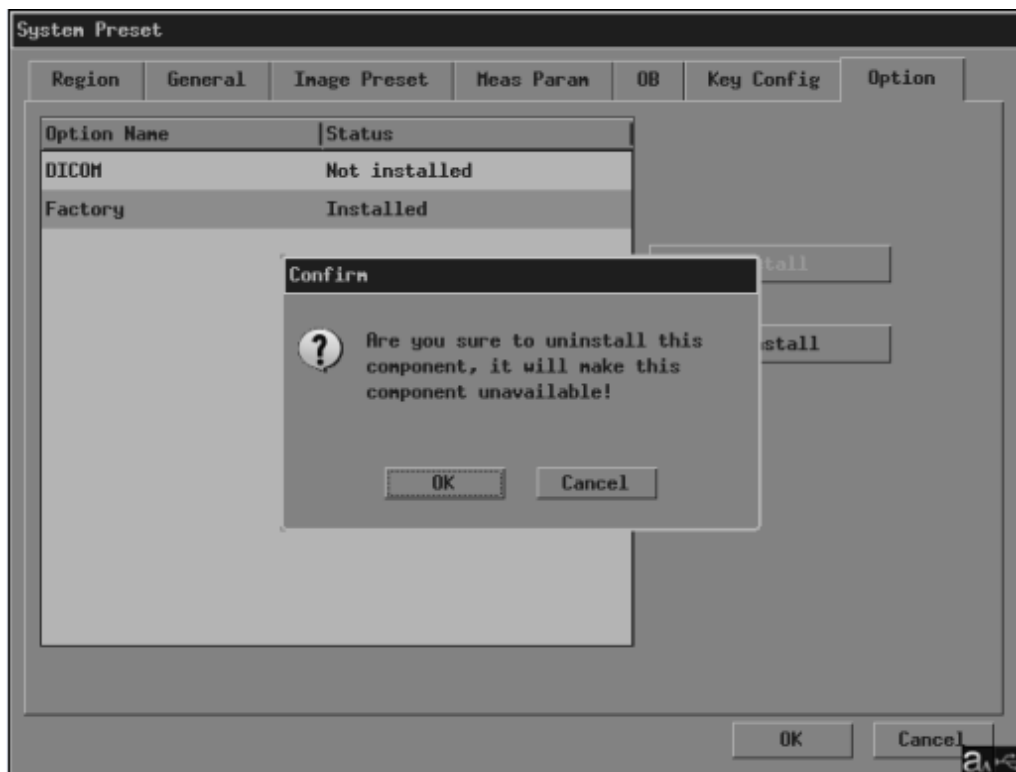
7.2.6 Installing and Uninstalling the Software of Optional Devices

7.2.6.1 Installing Optional Software

1. Copy dicom.key based on the MAC address of any device into U flash drive.
2. Enter [Preset] menu (refer to 7.2.1 Preset), and click [System Preset].
3. Select [Option] in the dialog box of [System Preset].
4. Select [DICOM], click [Install] to pop up the dialog box, in which, select corresponding key file to confirm the installation. After installation, it displays "installed" in [DICOM] item.
5. Click [OK] to exit the current page.
6. Enter [System Preset] menu and [System Information] again to review that [DICOM] is added in [System Preset] menu and "DICOM installed" is displayed in [System Information].

7.2.6.2 Uninstalling Optional Software

1. Enter [Preset] menu (refer to 7.2.1 Preset) and click [System Preset].
2. Select [Option] in the dialog box of [System Preset].
3. Select the item to be uninstalled in the list of [Option] list, click [Uninstall] and then click [OK].



4. Click [OK] to exit the current page. Enter [System Preset] menu again to review that [DICOM] is not in [System Preset] menu and “not installed” is displayed in [DICOM].

7.2.7 System Self test

7.2.7.1 Checking Item

1. Front End Test item: automatic self test; output results: pass or fail, including three items:
 - ADS5277 test
 - VCA8617 test
 - TLV5626 Test
2. Power Voltage Test item: automatic self test; output results: testing voltage value of PIN, including three items:
 - Pin 7(13.500V) voltage value
 - Pin 8(12.000V) voltage value
 - Pin22(PHV) voltage value
 - Pin13(3.300V) voltage value
 - Pin15(2.500V) voltage value
 - Pin21(5.000V) voltage value

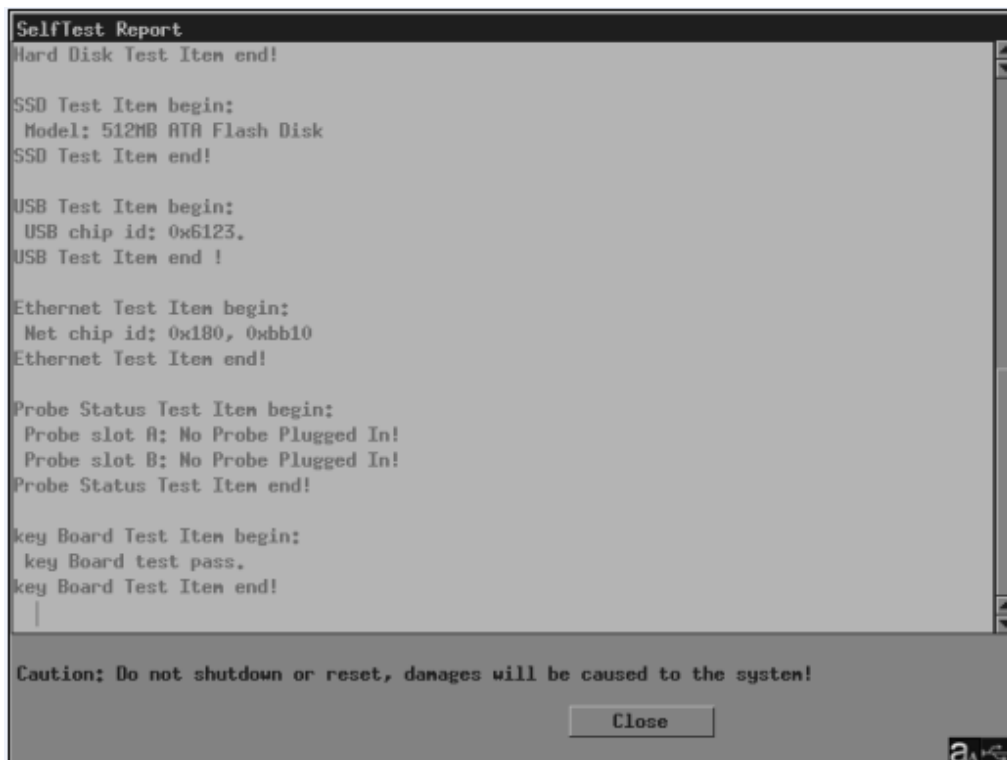
- Pin23(1.200V) voltage value
 - Pin24(-5.000V) voltage value
 - Pin25(3.000V) voltage value
 - Pin28(-1.500V) voltage value
3. Clock Battery Test Item: automatic self test; output results: voltage value of main board battery. (because the influence of diode voltage, the voltage value of main board battery is not exact, eg. the reading of no battery is 0.624V):
 - Battery(3.000V) voltage value
 4. Fan Status Test Item: automatic self test; output results: pass or fail; if fan is blocked or power is off, the result is fail.
 - Fan test passed
 5. Hard Disk Test Item: automatic self test; output results: model of optional hddisk or no its information.
 - Model: WDC WD800AAJS-60PSA0
 6. SSD Test Item: automatic self test; output results: capacity and model of SSD hddisk or no its information.
 - Model: 512MB ATA Flash Disk
 7. USB Test Item: automatic self test; output results: USB chip ID, or chip malfunction information.
 - USB chip id: 0x6123
 8. Ethernet Test Item: automatic self test; output results: network chip ID, or chip malfunction information.
 - Net chip id: 0x180, 0xbb10
 9. Probe Status Test Item: automatic self test; output results: probe model in A or B socket, or no probe is found.
 - Probe slot A: Connected, Probe Id: 5
 - Probe slot B: No Probe Plugged In!
 10. Key Board Test Item: manual interactive self test; output results: select Pass or Fail according to the self test situation.
 - key Board test fail
 11. Other information: probe board ID, Board ID (main board ID), keyboarded (keyboard ID) etc. will be saved in self test log file with system information.

7.2.7.2 Self test

1. Enter [Preset] menu (refer to 7.2.1 Preset).
2. Click [Maintenance], and enter the password.
3. Click [Self test] to pop up the dialog box of [Confirm], and then click [OK] to continue self test.
4. Self test results for each item will be displayed on the screen of [Selftest Report].

CAUTION:	Do not turn off the power supply in the process of self test; otherwise, it will damage the system.
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5. Keyboard self test: includes key test and light test.
 - Key test: press keyboard key or rotate knob, if the corresponding key on the screen blinks and marks background, it indicates the response is in effect.
 - Light test: Move the cursor onto [Light Test] button, press [Set] key, and the lights will be on in circulation for three times, which indicates the light test is in process.
6. Self test result: because keyboard self test is a manual interactive process, operator can estimate the result (pass or fail) based on the manual check process. Move the cursor onto [Pass And Quit] or [Fail And Quit], and press [Set] to exit keyboard self test screen and output corresponding self test result.



CAUTION:	Do not shutdown or reset; otherwise, it will damage the system.
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7. Self test log review: click [Close] on the screen of [Self test Report] to exit, and then pop up a dialog box, in which, shows the saved self test log including system information

and self test report.

- Export self test log: click [Export] on the screen to pop up the [Save as] dialog box, in which select storage path, enter file name and click [OK] to confirm it.
- Close review screen: click [Close] on review screen to exit the current screen.



8. On the screen of [Shut down information], there is no response after pressing any key; you can only disconnect the power.

8

Troubleshooting

8.1 USB can't be Recognized

- 1) Confirm whether to use USB device with over 1A bus mains supply.
- 2) If the surge causes USB port can't be used, please restart the system.

8.2 Abnormal System Clock

- 1) Potential Causes: there is no power in button-shaped battery.
Troubleshooting: replace new button-shaped battery.
- 2) Potential Causes: RTC clock on main board can't work normally (the malfunction probability is rather low).
Troubleshooting: replace main board.

8.3 System Power, Fan Speed Check

Potential Causes: ADT7462 can't work normally.

Troubleshooting: if there is image displayed, and the voltage and fan speed are abnormal, it can make certain that ADT7462 is in malfunction. You can check log file to review malfunction record. Replace ADT7462 chip or main board.

8.4 The System can't be Started

Malfunction description: after the system is power on, waiting for a little long time, the monitor indicator is yellow.

Troubleshooting: replace power supply board or main board.

8.5 Blank Screen

Malfunction description: The screen is blank after switching on the system.

Troubleshooting:

- 1) If the monitor indicator is yellow, you should replace main board or power supply board.
- 2) If the monitor indicator is green (the system is started) and there is display, you should replace CRT assembly and connection board.
- 3) If there is no display, you should replace IO board. After replacing, if there is no

display, replace main board.

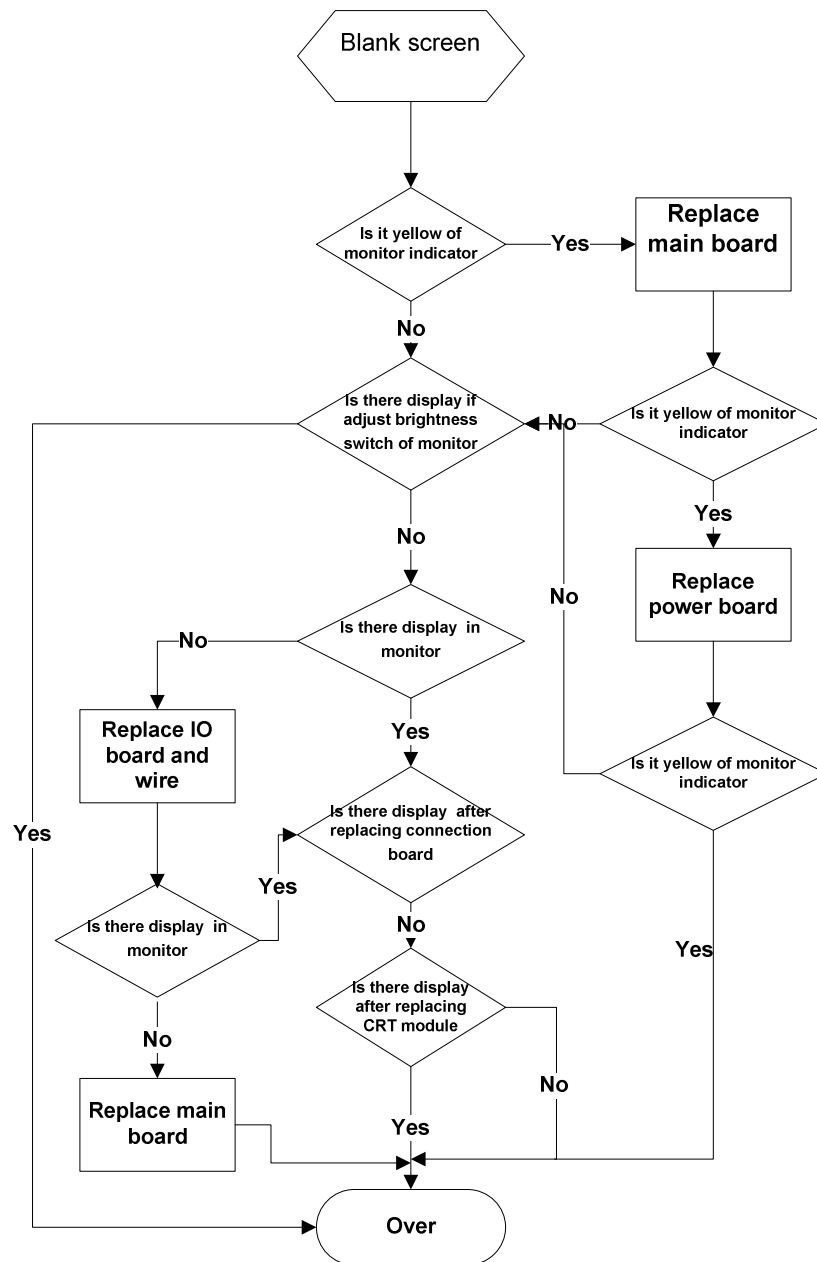


Figure 8-1 Examine and Repair Flow of Blank Screen

8.6 No Image Displayed in the Image Area

Malfunction description: there is no image displayed after the system is started.

Troubleshooting:

- 1) Replace probe;
- 2) Replace probe board;
- 3) Replace power module;
- 4) Replace main board.

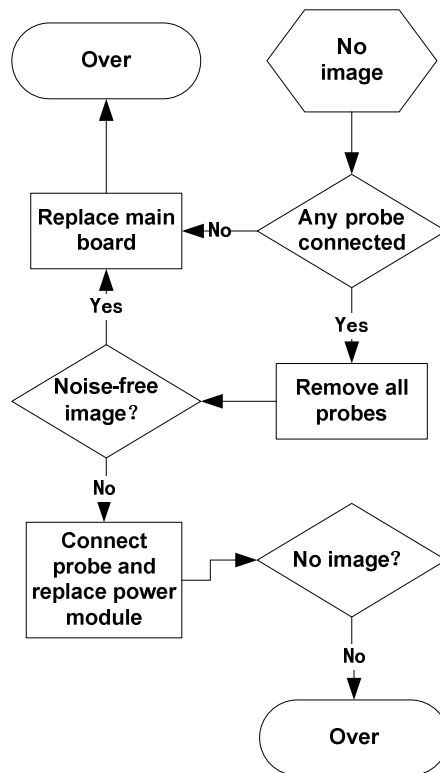


Figure 8-2 Examine and Repair Flow When No Image Displayed in the Image Area

8.7 Snow in Image

Malfunction description: there is snow-storm in image after the system is started.

Troubleshooting: the potential cause is time sequence of FPGA can't meet design index, or the problem of front-end chip. It's recommended to replace main board.

8.8 Application of Self test

8.8.1 Checking Voltage for Each Channel

According to system definition, the system can monitor most powers. When maintaining the device, you can review relating information if you can look over log file.

Power monitoring includes two types: general power and PHV power.

- If the wrong value recorded in the log is 0V, it indicates this power is broken circuit. You can check if the cooresponding fuse on the main board is burn out.
- If the voltage value recorded in the log is higher or lower, you should firstly try to change power module and do self test to check if there is abnormality. If there is, it indicates the relating circuit on the main board is damaged. If not, it indicates the power module is damaged.
- If the power monitoring circuit is damaged, the system will pop up the dialog box to warn the user to avoid serious malfunction.

8.8.2 Checking Electrical Quantity of Real-time Clock Battery

The system can monitor the electrical quantity of real-time clock. If the electrical quantity is low, please replace the battery in time.

8.8.3 Checking Fan Status

The system can monitor the fan. If the fan does not work, it may cause the temperature of the main engine high, even damage the devices. The malfunctions arose from fan breakdown is that the system is off because of power module protection after several hours of switching on. When the fan is breakdown, the system will pop up the dialog box to warn the user and write the relating information into log file.

8.8.4 Checking Peripheral Devices Interfaces

The system does maneuverability verification for harddisk (SSD and HDD), USB chip and network chip.

If there is relating peripheral operation failure, please do self test as soon as possible.

- If the self test result is normal:
 - (1) Check if the wire of relating peripheral is correct.
 - (2) Check if the wire inside the device is correct.

If the checks mentioned above are all correct, it indicates the relating circuit on main board is open or the function circuit is damaged. Please replace the main board.

- If the self test result is abnormal, it indicates relating function chip on main board is damaged. Please replace the main board.

8.8.5 Checking Correctness of Front End Control

System defines correctness verification for read-write operation of front-end all levels chip.

Incorrect control of front end chip may cause serious image bug. If there is image failure, please firstly do self test and confirm whether the operation of front end chip is correct.

If it is incorrect, please replace main board, record and feed back the self test result.

8.8.6 Checking Probe Board

Checking probe board can verify the correctness of relating control of probe board, which can estimate malfunction of probe.

8.8.7 Checking Keyboard Board

Keyboard malfunction will cause trackball and keys can't be rotated or pressed or other operation mistakes.

The incorrect response of specified key can be checked by self test and can be maintained by replacing thin-film switch.

8.9 Probe Board Malfunction

8.9.1 Single Socket Probe Board can't be Recognized

- 1) Malfunction description: probe ID can't be read and probe board ID can't be obtained (can be checked by self test).

Troubleshooting:

- a) Probe power is in failure (no probe connected, level of probe on site signal is not 3.3V), please replace probe board.
 - b) Main board interface circuit is in failure or FPGA of main board is damaged (the failure can't be removed after replacing probe board), please replace main board.
- 2) Malfunction description: probe ID can't be read but probe board ID can be obtained.
 Troubleshooting: control signal of probe board ID is in failure. If the failure can't be removed after replacing probe board, it can confirm that main board is in failure.

8.9.2 Double Sockets Probe Board can't be Recognized

- 1) Malfunction description: Probe ID can't be read and probe board ID can't be obtained (this can be checked by self test).

Troubleshooting:

- a) Probe power is in failure (no probe connected, level of probe on site signal is not 3.3V), please replace probe board.
 - b) Main board interface circuit is in failure or FPGA of main board is damaged (the failure can't be removed after replacing probe board), please replace main board.
- 2) Malfunction description: probe ID can't be read but probe board ID can be obtained.
 Troubleshooting: control signal of probe board ID is in failure. If the failure can't be removed after replacing probe board, it can confirm that main board is in failure.
- 3) Malfunction description: no matter probe A or probe B is connected, there is normal image in only half area of the screen and the position of A and B normal image are different.
 Troubleshooting: the relay control circuit is in failure. The probable reason is probe malfunction. Please replace probe board.

8.10 Malfunction of Control Panel

- 1) Malfunction description: D4 of LED is not on.

Troubleshooting: there is no 5V mains supply for control panel. Check 5V power circuit of

control panel.

- 2) Malfunction description: keyboard doesn't work normally and D3 of LED is on, but D63 is not on.

Troubleshooting:

- a) FPGA configuration is not succeeded. There is no writing file. Write it.
- b) Confirm FPGA voltage is normal or not. Measure the voltage drop from two sides of C125. The standard value is 1.2V, if it is not reached, replace U3.
- c) Confirm FLASH voltage is normal or not. Measure the voltage from two sides of C127. The standard value is 3.3V, if it is not reached, replace U28.
- d) FLASH is in failure. Replace U26.
- e) FPGA is in failure. Replace U27.

- 3) Malfunction description: main unit can't communicate with control panel.

Troubleshooting:

- a) The wire between keyboard and connection board is in failure. Check if the wire is connected right or not.
- b) The control circuit is in failure.

- 4) Malfunction description: there is no any sound when pressing the key.

Troubleshooting:

- c) The wire of speaker is in failure. Check if the wire is connected right or not.
- d) Speaker is damaged. Pull it out, connect positive electrode of dry battery of size 5 to "+" on the speaker with wire, and then touch "-" point of the speaker with negative electrode of battery. If you can hear ringing "dada" sound, it indicates the function of speaker is normal, otherwise it's in failure.

- 5) Malfunction description: trackball can't work.

Troubleshooting:

- a) The wire of trackball is in failure. Check if the wire is connected right or not.
- b) Trackball is damaged. Check if there is much dust in trackball or it is damaged.

- 6) Malfunction description: key can't be responded.

Troubleshooting:

- a) The connection of thin-film switch is in failure. Check if the socket of thin-film switch is plugged well or not.
- b) Thin-film switch key is damaged. Check if the silk screen of thin-film switch key is broke or not.

8.11 Troubleshooting of Power Supply Board

Before troubleshooting, connect the power supply board to load by the way in Figure 8-3. Load

A is necessary, load B is decided by the situation. In order to be convenient for maintenance under some specified situations, please note that the current value of load B can't be over 0.1A and load B can only be loaded when other output is at the lowest value.

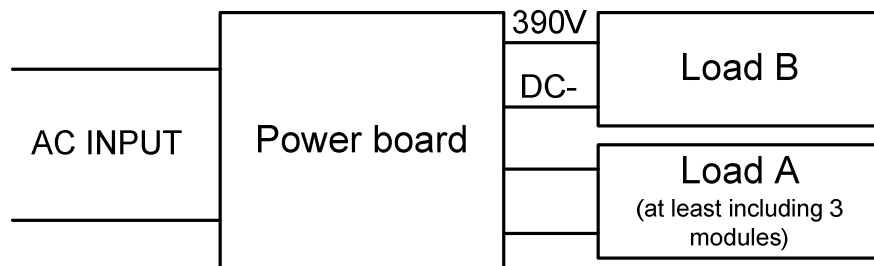


Figure 8-3 Connection Sketch Map of Power Supply Board Checking

Because there are many output channels on the board, considering practical situation, you can only connect load to +5V, +13.5V and HV. In addition, in order to be convenient for debugging, it's recommended to begin the debugging with higher load than the nominal one. During the debugging process, increase the load according to the real situation. After confirming the connection of boards is correct, you can troubleshoot the malfunction based on flow in Figure

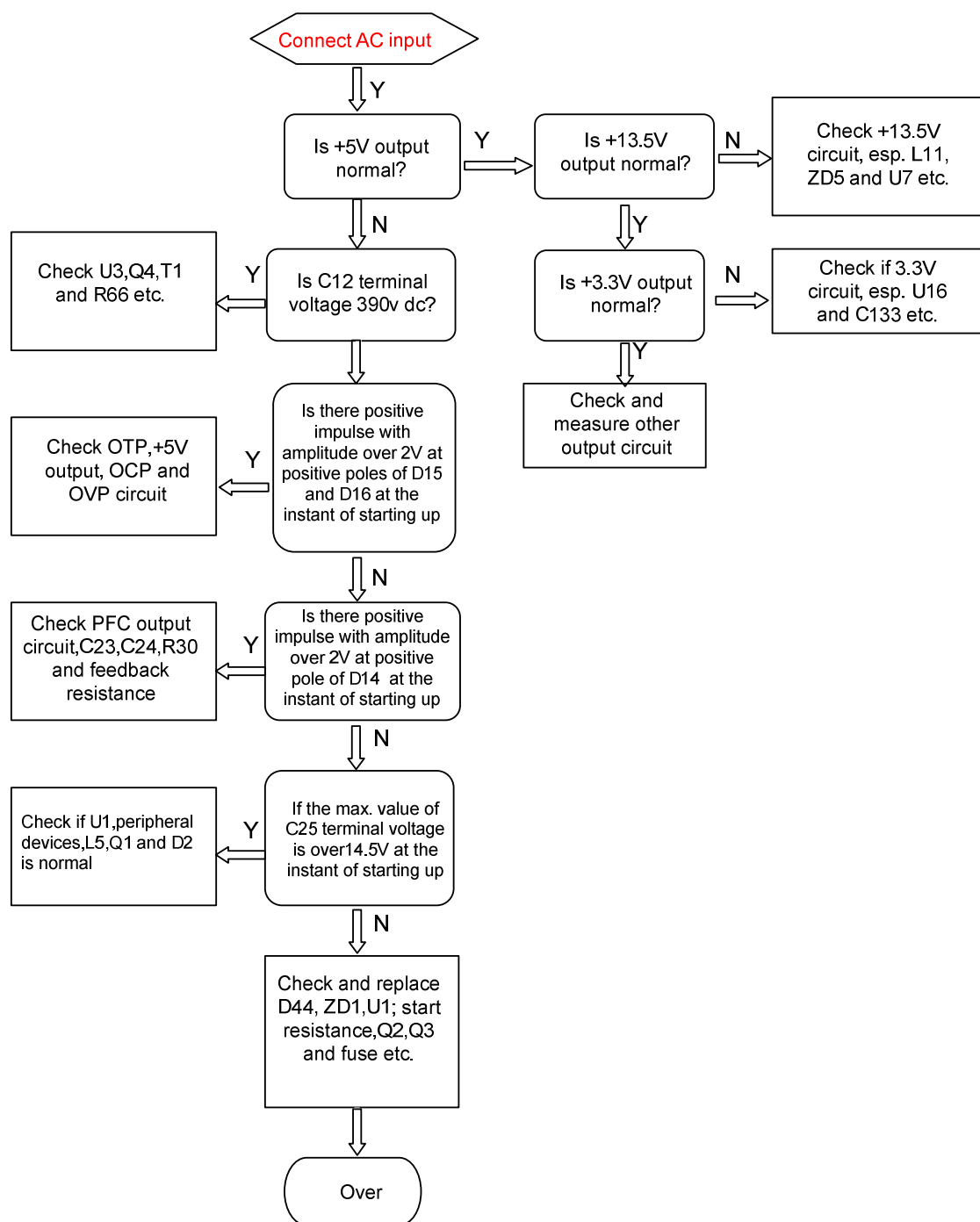


Figure 8-4.

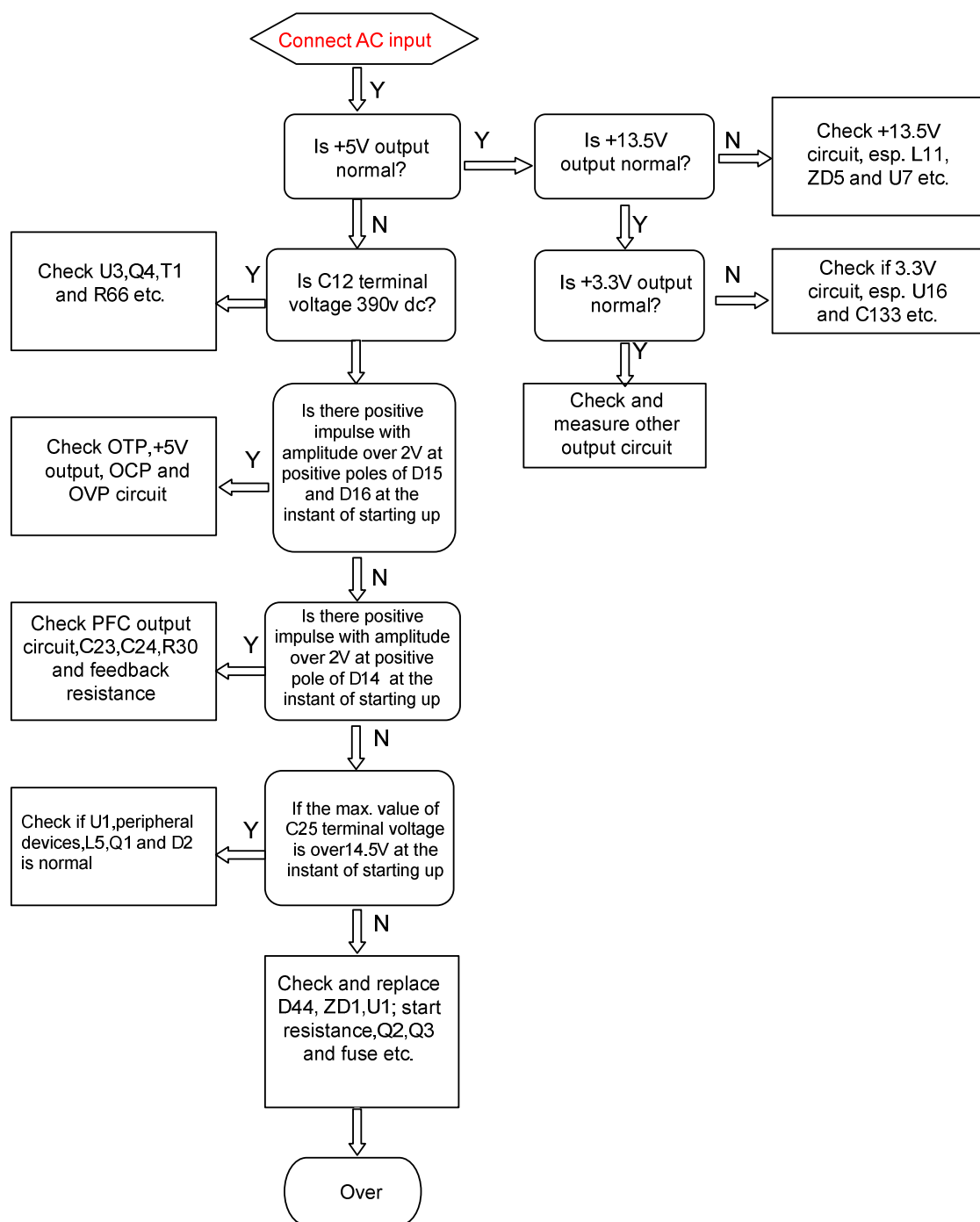


Figure 8-4 Check Flow of Power Supply Board Malfunction

Of course, considering the complexity of boards, the flow described above is only for basic instruction. You should analyse the detailed reason based on the specified malfunction phenomenon.

NOTE:

Because of high voltage of power supply board, please be careful at test. Not only take care of correct use of measurement device to avoid damaging device or board, but also tester's safety. In particular under the situation of power on, never touch the devices on the board, especially high voltage part.

Appendix A Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PRO_{XL} International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Fluke, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

ELECTRICAL SAFETY INSPECTION

1- Power Cord Plug

TEST PROCEDURE

◆ The Power Plug

The Power Plug Pins	No broken or bent pin. No discolored pins.
The Plug Body	No physical damage to the plug body.
The Strain Relief	No physical damage to the strain relief. No plug warmth for device in use.
The Power Plug	No loose connections.

◆ The Power Cord

The Power Cord	<p>No physical damage to the cord. No deterioration to the cord.</p> <p>--For devices with detachable power cords, inspect the connection at the device.</p> <p>--For devices with non-detachable power cords, inspect the strain relief at the device.</p>
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ELECTRICAL SAFETY INSPECTION

2- Device Enclosure And Accessories

TEST PROCEDURE

◆ Visual Inspection

The Enclosure and Accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

◆ Contextual Inspection

The Enclosure and Accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

ELECTRICAL SAFETY INSPECTION

3- Device Labeling

TEST PROCEDURE

Check the labels provided by the manufacturer or the healthcare facility are present and legible.

- *Main Unit Label*
- *Integrated Warning Labels*
- *Slope and High Voltage Caution Label*
- *Don't Stress Label*

ELECTRICAL SAFETY INSPECTION

4- Protective Earth Resistance

VOERVIEW

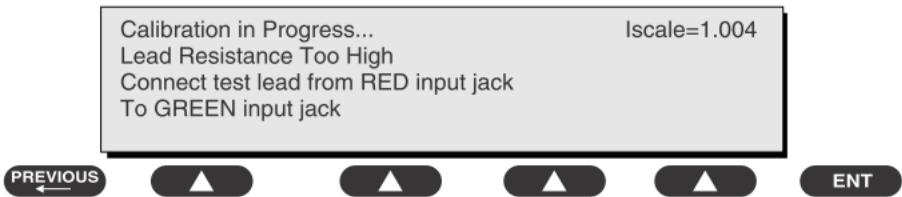
Protective Earth Resistance is measured using the RED test lead attached to the DUT Protective Earth terminal or enclosure. Select the test current by pressing SOFT KEY 3 to toggle between 1AMP, 10AMP, and 25AMP. The front panel outlet power is turned off for this test.

The following conditions apply: L1 and L2 Open.

TEST PROCEDURE

◆ Prepare

- 1) First select the test current that will be used for performing the Protective Earth Resistance test by pressing AMPERES (SOFT KEY 3).
- 2) Connect the test lead(s) between the RED input jack and the GREEN input jack.
- 3) Press CAL LEADS. The 601PRO will measure the lead resistance, and if less than 0.150 Ohms, it will store the reading and subtract it from all earth resistance readings taken at the calibrated current.



- 4) If the calibration fails, the previously stored readings will be used until a passing calibration has occurred.

◆ WARNING

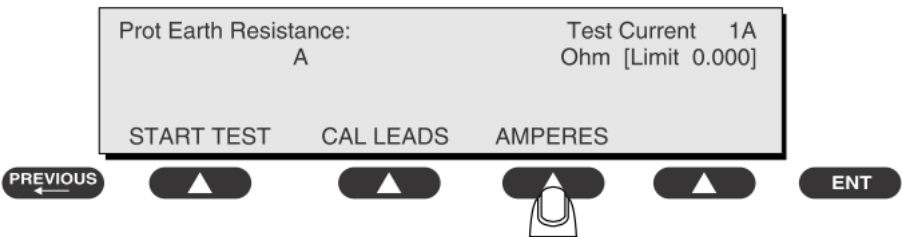
During Earth Resistance testing, the DUT must be plugged into the 601PRO front outlet. If the DUT fails Earth Resistance, discontinue tests and label the device defective.

◆ Perform the Test

ELECTRICAL SAFETY INSPECTION

4- Protective Earth Resistance

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet.
- 2) Attach the 601PRO RED input lead to the device's Protective Earth terminal or an exposed metal area.
- 3) Press shortcut key 3. The Protective Earth Resistance test is displayed.
- 4) Press SOFT KEY 3 to select a test current (1AMP, 10AMP, or 25AMP). The selected test current is displayed in the upper right corner of the display.



- 5) Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.
- 6) Press the print data key at any time to generate a printout of the latest measurement(s).

◆ **Note**

When "Over" is displayed for Ohms, this signifies that a valid measurement was not obtained because either an open connection was detected or that the measurement was not within range. Readings greater than 9.999 Ohms will be displayed as Over.

◆ **Failure**

Once it reaches the limitation, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

ALL COUNTRIES R = 0.2Ω Maximum

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

OVERVIEW

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

Leakage current is measured the following ways:

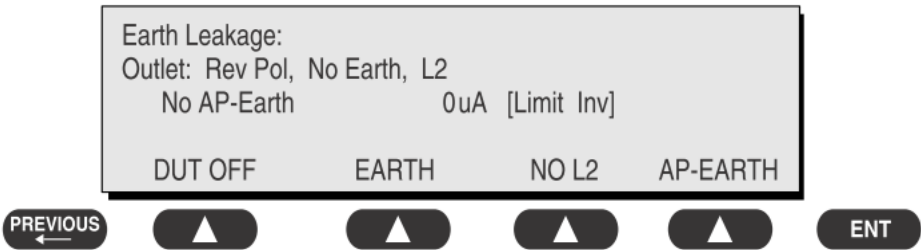
- ◆ Earth Leakage Current, leakage current measured through DUT outlet Earth
- ◆ Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

There is no need to attach a test lead; the 601PRO automatically connects the measuring device internally.

TEST PROCEDURE

◆ Perform the Test

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the device's applied parts to the 601PRO applied part terminals if applicable.
- 3) Press shortcut key 4. The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
 - SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
 - SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
 - SOFT KEY 4 toggles the AP to Earth to No AP to Earth.
- 4) Press the print data key at any time to generate a printout of the latest measurement.

◆ Failure

Check any broken of the AC/DC adapter and its cable. Replace a new one if any portion defective.

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

- For UL60601-1: 300 μ A Normal Condition
- 1000 μ A Single Fault Condition
- For IEC60601-1: 500 μ A Normal Condition
- 1000 μ A Single Fault Condition

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

OVERVIEW

Patient leakage currents are measured between a selected applied part and mains earth. All measurements may have either a true RMS or a DC-only response.

TEST PROCEDURE

◆ Prepare

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

Normal Polarity, Earth Open, Outlet ON	Normal Polarity, Outlet ON
Normal Polarity, L2 Open, Outlet ON	Reversed Polarity, Outlet ON
Reversed Polarity, Earth Open, Outlet ON	Reversed Polarity, L2 Open, Outlet ON

◆ WARNING

If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆ Perform the Test

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the applied parts to the 601PRO's applied part terminals.
- 3) Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current



- 4) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.
- 5) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.
- 6) Press the print data key at any time to generate a printout of the latest measurement.

◆ Note

If the current test standard being used does not include Patient Leakage DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections. Refer to Chapter 8, Standards and Principles.

◆ Failure

Check any broken of the AC/DC adapter and its cable. Replace a new one if any portion defective.

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

LIMITS

For BF :transducer

100 μ A Normal Condition

500 μ A Single Fault Condition

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

OVERVIEW

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions as indicated on the display.

The following outlet conditions apply when performing the Mains on Applied Part test.

Normal Polarity;

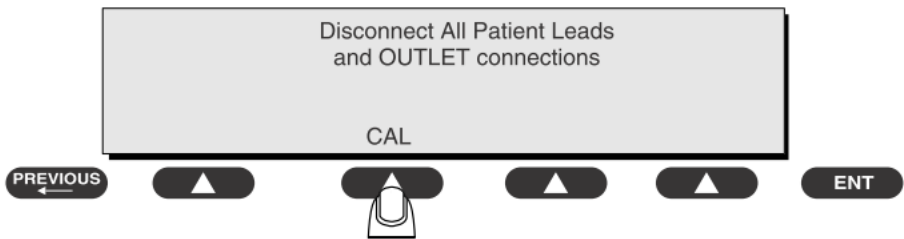
Reversed Polarity

TEST PROCEDURE

◆ Prepare

To perform a calibration from the Mains on Applied Part test, press CAL (SOFT KEY 2).

- 1) Disconnect ALL patient leads, test leads, and DUT outlet connections.
- 2) Press CAL to begin calibration, as shown:



If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

- 3) When the calibration is finished, the Mains on Applied Part test will reappear.

◆ WARNING

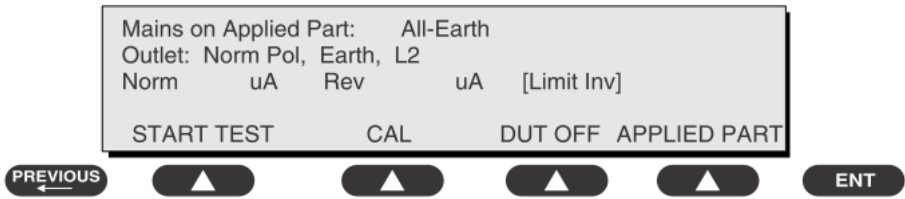
- 1) A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.
- 2) High voltage is present at applied part terminals while measurements are being taken.

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

◆ Performance

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601
- 2) Attach the applied parts to the 601PRO applied part terminals.
- 3) Attach the red terminal lead to a conductive part on the DUT enclosure.
- 4) Press shortcut key 7. The Mains on Applied Part test is displayed.



- 5) Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:
- 6) Press START TEST (SOFT KEY 1) to begin the test.
- 7) Press the print data key to generate a printout of the latest measurement.

◆ Note

If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆ Failure

Check any broken of the AC/DC adapter and its cable. Replace a new one if any portion defective.

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For BF: transducer

5000 μ A

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

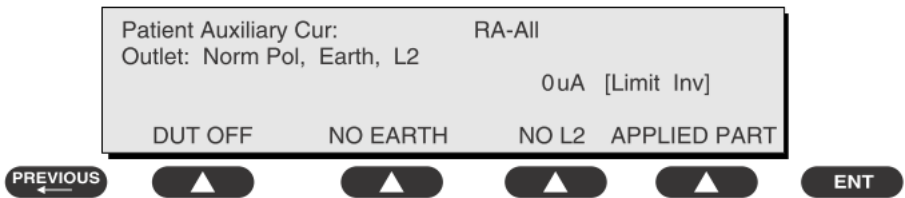
OVERVIEW

Patient Auxiliary currents are measured between any selected ECG jack and the remaining selected ECG jacks. All measurements may have either a true RMS or a DC-only response.

TEST PROCEDURE

◆ Prepare

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the patient leads to the 601PRO ECG jacks.
- 3) Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).
- 4) Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.



- 5) Press SOFT KEYS 1-4 to select leakage tests
- 6) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
- 7) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
- 8) Press the print data key at any time to generate a printout of the latest measurement.

◆ Note

If the current test standard being used does not include Patient Auxiliary Current DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections.

◆ Failure

Check any broken of the AC/DC adapter and its cable. Replace a new one if any portion

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

defective.

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For BF: ECG Input

100 μ A Normal Condition

500 μ A Single Fault Condition

ELECTRICAL SAFETY INSPECTION FORM**Overall assessment:**

Scheduled inspection	Test item: 1, 2, 3, 4, 5, 6, 7, 8
Unopened repair type	Test item: 1, 2, 3
Opened repair type, not modify the power part including transformer or patient circuit board	Test item: 1, 2, 3, 4
Opened repair type, modify the power part including transformer	Test item: 1, 2, 3, 4, 5
Opened repair type, modify patient circuit board	Test item: 1, 2, 3, 4, 6, 7, 8

Location:				Technician:	
Equipment:				Control Number:	
Manufacturer:		Model:		SN:	
Measurement equipment /SN:				Date of Calibration:	
INSPECTION AND TESTING				Pass/Fail	Limit
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	____ μA		Max: NC: 300 μA (refer to UL60601-1) * NC: 500 μA (refer to IEC60601-1) * SFC: 1000 μA
		Single Fault condition(SFC)	____ μA		
6	Patient Leakage Current	Normal condition(NC)	<input type="checkbox"/> BF ____ μA		Max: BF applied part: NC:100 μA , SFC: 500 μA
		Single Fault condition(SFC)	<input type="checkbox"/> BF ____ μA		
7	Mains on Applied Part Leakage		<input type="checkbox"/> BF ____ μA		Max: BF applied part: 5000 μA
8	Patient Auxiliary Current	Normal condition(NC)	<input type="checkbox"/> BF ____ μA		Max: BF applied part: NC:100 μA , SFC: 500 μA
		Single Fault condition(SFC)	<input type="checkbox"/> BF ____ μA		

Note:

The equipment which sell to America shall comply with the requirement of UL60601-1, others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____

Date: _____

